A McGraw-Hill Publication

June 12, 1930

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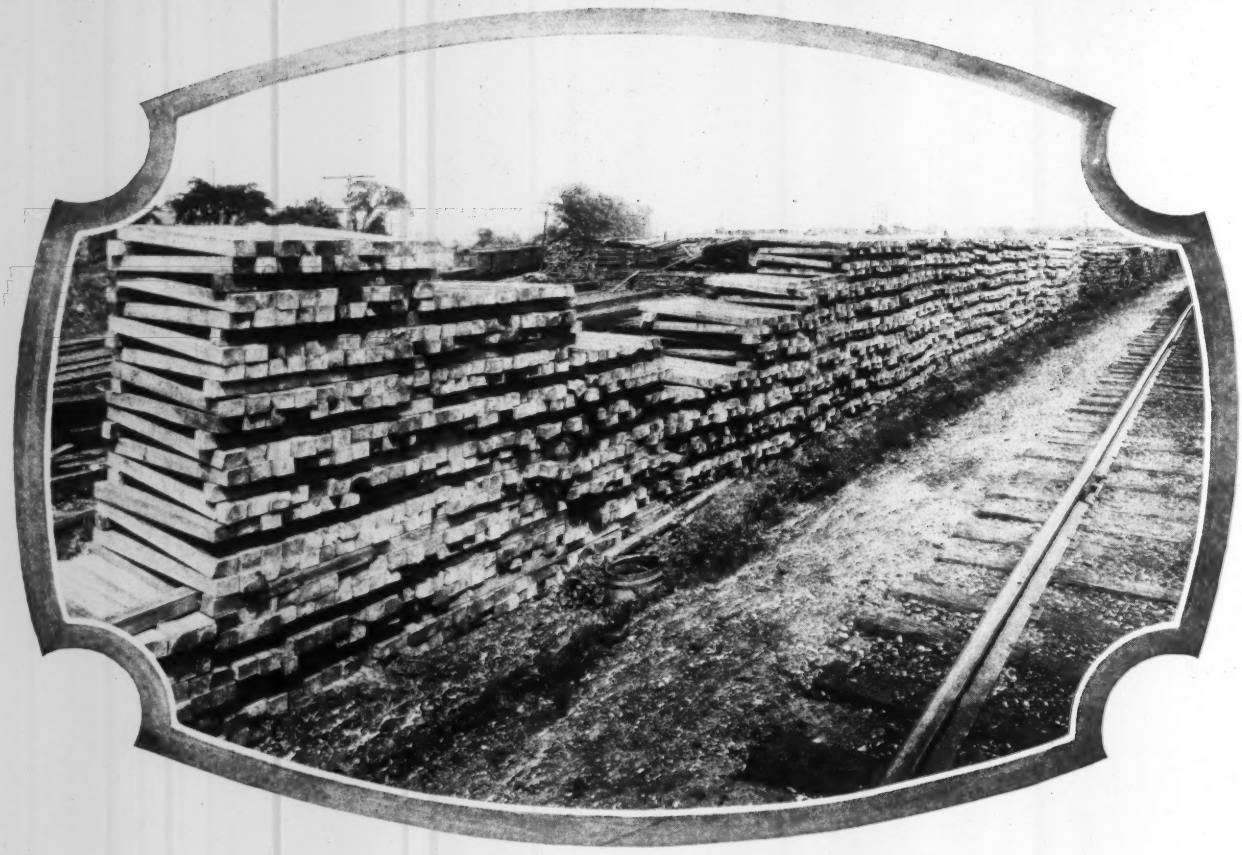
Engineering News-Record

Form Gantry for Rock Storage Bin Walls
East Chicago, Ind.

KREOLITE



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A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

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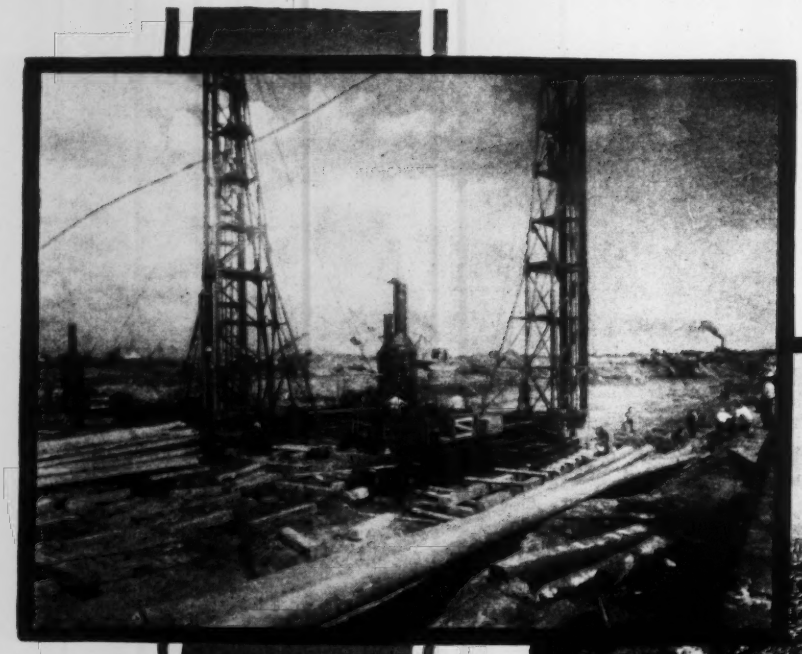

Great Lakes Steel Mill to Be Ready in Late Summer

The Great Lakes Steel Corporation, a unit of the National Steel Corporation, will have its $20,000,000 plant at Detroit completed and will start making steel by the latter part of August or early in September, according to an announcement by George R. Fink, president of National Steel.

"Construction work at our Detroit mill is progressing rapidly," said Mr. Fink, "and we will have the plant completed on schedule, notwithstanding the fact that the work has been delayed a little by one of the most severe winters in history.

"Completion of this plant will mark another step in the development of Detroit as a steel center. The Great Lakes plant will have a capacity of 500,000 tons a year at the outset, and is so constructed that capacity can be enlarged as needed. It will make bars, shapes and sheets. It is ideally situated, from the standpoint of transportation, with waterfront rights on the Detroit River and sidings from the Michigan Central and Detroit, Toledo & Ironton Railroads.

"The output of the Great Lakes plant can be largely marketed in the Detroit industrial area, although the company, through the freight advantages which it enjoys, will also be in position to compete advantageously for business in many other territories, including the Atlantic Coast and export markets. Michigan in 1928 consumed 2,343,000 tons of steel aside from steel rails. Of this total, 870,000 tons was made up of sheets, 131,000 tons of rolled shapes, and 722,000 tons of bars. Our new plant will be in an ideal position to handle the steadily growing tonnage of these products."

The Iron Age, February 27, 1930.

Job 2478

Owner: Client: Architects: Engineers:

GREAT LAKES STEEL CORPORATION

April 15, 1930

Number of wood piles, to date—29,110

Unit No. 2—1,234,712 L. F.
—16,998 piles
First pile driven—June 29, 1929
Last pile driven—Oct. 25, 1929

Unit No. 3—823,251 L. F.
—11,096 piles
First pile driven—Sept. 27, 1929
Last pile driven—(not completed)

Unit No. 14—41,535 L. F.
—576 piles
First pile driven—Feb. 11, 1930
Last pile driven—March 15, 1930

Unit No. 15—31,578 L. F.
—440 piles
First pile driven—Feb. 11, 1930
Last pile driven—March 1, 1930

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 104 NEW YORK, JUNE 12, 1930 Number 24

Two Kinds of Caution

ENGLAND'S rejection of the ancient and superficially rejuvenated project for a tunnel under the Channel, anticipated from the nature of the technical commission's report and confirmed last week, appears to be explained by both financial and military caution. The government implies that the tunnel will not pay, and it might serve to allow some wooden horse to be brought through the defenses—this latter argument, be it noted, in a year of international disarmament and professions of trust and amity. Very likely the financial argument was the convincing one; but the military argument, though perhaps mainly intended for the voters of the back-country districts, is so thoroughly interwoven with the entire history of the project as to give it a privileged status. The Briton's suspicion of any move to open his defenses is deeply enough rooted to require a strong promise of profit to overcome it. The tunnel has no such promise.

Optical Turnstiles

MODERNISM in bright contrast with the gray-haired venerability of the Channel tunnel project speaks out of another international trafficway, the Ambassador bridge, whose approach lanes are provided with a light-ray detector system for keeping check on entering traffic. Photo-electric detectors there, performing on a large scale what they have done on smaller scale in machines of various kinds, represent a new instrument of potentially large future application, since with aid of electron-tube amplifiers they can bring great amounts of power into instant response to a disturbance. What they do at the bridge could perhaps be performed as well by more familiar contact devices. They act as optical turnstiles, in fact. But in this very character, in their ability to detect without contact, lie the possibilities that promise to open for them a future almost as great in civil engineering fields as in the field of machinery. In the handling of traffic alone it will have much to do.

Canal Transits Decline

TRAFFIC through the Panama Canal is not increasing with such leaps and bounds as many of the Nicaragua Canal enthusiasts would have us believe. Recently the *Panama Canal Record* gave figures for the first ten months of the fiscal years 1928, 1929 and 1930, which are significant in view of the active consideration now being given to the proposed canal across Nicaragua. These figures show that while the tolls for 1930 are somewhat higher than those for either of the two previous years, the total number of commercial transits, the governing factor in determining canal capacity, is less than in 1928 or 1929. The number of transits for the first ten months in each of the three years is 5,467, 5,386 and 5,228—a steady decrease. The increase in tolls over transits indicates that more large vessels are using the canal, which in itself suggests a change in character of the canal traffic that may materially affect present estimates of the future capacity of the canal. But there is nothing in the record to indicate that we are rapidly approaching the day when the Panama Canal will not be ample for the traffic offered.

A True Superhighway

THE spectacular highway viaduct structure described in this issue is the closing link in the great approach road from New Jersey to the Holland vehicular tunnel under the Hudson River to New York City. Two other links, a viaduct and subway through Jersey City and a viaduct through Newark, have already been constructed, both (like the present link) without a crossing at grade and both with a 50-ft. roadway. Undoubtedly this 8-mile viaduct highway is the most costly intercity public road ever constructed; indeed, only a few double-deck city streets—like the Wacker Drive in Chicago and the West Side elevated boulevard in New York City—can compare in cost, and none has afforded more intricate problems in engineering design. In all respects the structure which collects and distributes the Holland tunnel traffic in New Jersey is a worthy accessory to the great subaqueous travel route of which it is a continuation. It is a credit to the state highway engineers and commissioners of New Jersey that in meeting the problem which confronted them they considered no solution less than the best. The 3-mile portion of the highway described and illustrated includes difficult river crossings, but otherwise does not surpass in either design or structure the portions previously constructed. The whole enterprise is superhighway in the fullest meaning of the term.

Credit and Building

EVENTS of recent times bring out rather clearly the failure of our business credit system, the banking system, to provide ready means for financing house construction. From the important position given to this question of financing at the recent international building congress in London it appears that the difficulty is not confined to the United States but that all countries suffer from a similar misadjustment. Its reasons have never been sought out, unfortunately, although regulated house-building conditions are important to the entire community. House building is one of the major industries, and its ups and downs—consider only the past two years!—impress themselves on business activity in general. Doubtless the banking system is partly responsible for the shortcomings of building finance, but much blame must be placed on the technical and industrial phases of house construction. As brought out in a discussion in a later column, the art suffers from lack of modernization. It also suffers from the lack of in-

dexes or guarantees of value. House value is not truly measured by cost but may be reduced by effect of location, planning, and quality of construction—or, in rare instances, may be increased by them. Excellence and efficiency of construction would seem to be matters for engineering industry to control. Modernization of method is one direction of advance; standardization and guarantee of quality is another. When these are taken care of, the way will be clearer for setting up suitable financing facilities—a badly needed improvement.

District Enterprise for Reclamation

DISTINGUISHED from other municipal district operations by its threefold purpose, flood-control, drainage and irrigation, the Middle Rio Grande district work is yet closely similar to many irrigation district operations. The Albuquerque region is well settled up and the present enterprise is one of improvement rather than one of bringing in and colonizing new land, so that it escapes the difficulties that beset irrigation districts in so many instances—difficulties due sometimes, perhaps, to shortsighted planning or to water-rights controversies, but more often to the unavoidable overhead of slow settlement. During the past two decades, the existence of the federal reclamation system, with its virtual donation of half the cost of the water-supply system, tended to make self-supporting district enterprises rather hopeless. At present a presidential board is meeting to study possible improvement of the reclamation law. Its greatest possibility lies in devising a system which shall restore district initiative to its proper position as the leading method of conducting land reclamation.

Association Progress

FIFTY years at the longest is the life span thus far of most of the many existing technical societies. Besides growth of membership, there have been marked changes in organization, procedure and accomplishment during the life of even the younger organizations; but in all those respects there is still far to go. Membership should be largely increased. Organization and procedure, even if reasonably satisfactory now, must be changed frequently to meet new conditions, particularly as regards committee work. Notable progress in these respects has been made in the last ten years by the American Water Works Association. The membership is well toward three thousand. The administrative machinery has been modernized and the committee work strengthened. The programs are much better planned of late than formerly. This year's program was notable in choice and arrangement of topics, in cutting down the number of subjects for consideration and in selecting the names put on the program. But general discussion was almost wholly lacking. If the association programs were modified to elicit voluntary discussion, the already great usefulness of the association would be further increased.

More Exploration Needed

HUNDREDS of communities draw their water supplies from underground sources. Often the yield diminishes rapidly in a few years or is kept up by increasing the expense for pumping. Such disappointment and growing expense are in large part due to poor planning and that in turn is caused by lack of knowledge of underground water flows or failure to utilize what is known. A paper at last week's water-works convention designed to simplify the complicated Slichter formula for underground flows, together with the accompanying discussion, suggested a field for committee work. With hundreds of wells available for observation many data of great probable aggregate value could be obtained in a few months or years, especially if a committee of specialists had the co-operation of voluntary local observers. The subject is fascinating, and the results promise extensive usefulness; only leadership and modest funds seem to be needed to get a study of it under way.

A House-Building Industry

THE recent announcement by two of the principal mail-order houses that their new plan for selling ready-made houses is meeting with success constitutes more than a mere item of market news. It is an indication that industry's method—large-scale factory operation, supply of a variety of products to meet different purses, and provision of a financing plan to assist the prospective purchaser—is workable in the house-building field. In addition, it calls attention not only to the practicability of making house building efficient but to the immediate need for other attempts in the same direction.

In this journal three or four months ago T. J. Foster in a series of three articles presented an enlightening summary of house-building conditions and proposed to remedy the existing inefficiency by a merchandising corporation with methods not unlike those of mail-order houses but patterned more closely after industrial methods. These articles will bear rereading, principally because for years the entire engineering fraternity has regarded the art of house building as beneath its notice, when it condescended to think of it at all. Industrialists also, though their astuteness, scientific planning and business foresight had radically reduced the cost of countless necessities and conveniences and at the same time improved their quality, failed to see that house building could be modernized by the same way.

It is no secret that the average house today is a shoddy affair, of high first cost, and soon reduced to a condition requiring constant maintenance; that it is built as it was built a great many years ago, by hand methods, with every piece cut in the field by men whose horizon is limited to the locality in which they live, whose training is of a sort that makes them impervious to the adaptation of new methods, whose financial capacity does not permit of modern research or study, in case they do recognize their value, and who themselves often are the victims of profiteering materials dealers. Today there are available better automobiles, better furniture and even better office buildings than were available only ten years ago, and they cost less. But the average house not only costs more today than it did in the days of our fathers and grandfathers, but it is an inferior product.

What is the solution? It would seem plausible that, in view of experiences in other fields, an attempt to substitute shop manufacturing methods for the hand methods of field cutting and fitting now in use for house building should produce improvement. Previous efforts based (at least nominally) on this principle failed; Mr. Foster, in the articles referred to, attributed their failure to the fact that most of them were sponsored by materials interests looking solely for increased sales volume. The question is one of method primarily, and

material only in second order. Wood, steel, gypsum, brick or concrete will each find its proper place in the scheme after the important matter of method has been disposed of.

The basic need is to transform the house-building field from a poorly organized craft into an industry such as serves the office-building field, for instance. Transfer as many as possible of the cutting and fitting jobs to the shop, where they can be controlled and improved and lowered in cost; use those materials which modern research has developed, and use them in their proper place; reduce field labor costs to a minimum; and, finally, make a sincere effort to give the house purchaser a better structure at a reasonable cost.

If engineers and industrialists would give to house building the thoughtful planning and technical foresight that they have lavished on other branches of industry, a remarkable renaissance would soon be under way. Until they do, house building will continue to harass the citizen. Also important to the civil engineer is the fact that the condition of the house-building field periodically crops up to cast a blot on his profession—as witness the recent Carnegie Corporation report on housing costs, which was interpreted by all the newspapers as referring to civil engineering work in general. Solving the house-building muddle is not a problem for citizens' committees, congressmen or philanthropists. It is up to the engineer, the organizer and the financier.

A New Attack on Engineers

A CHARGE that responsibility for the recent attempt in New York State to limit the activities of engineers rested upon the American Institute of Architects was made in these columns recently. That charge has not been denied. Much of the evidence in support of it was circumstantial, but of a substantial character. Now comes some further and more direct evidence to support the claim that it is the Institute, not a small group of malcontents, which is fostering the present unfortunate controversy between the two professions.

Within the past few weeks the New York State Court of Appeals heard a test case to determine the constitutionality of section 300 of the multiple-dwelling law. Section 300 states that plans and specifications for multiple dwellings or alterations thereto shall be filed by "the owner in person or by a registered architect acting as his agent." The court upheld the constitutionality of the section without opinion. Immediately following the publication of the court's decision, the American Institute of Architects sent a statement to the newspapers which said, in part: "One of the most troublesome factors in city building operation has been the deliberate dependence of owners and engineers upon officials of the tenement house department and the building bureau in the filing of plans which would conform to municipal regulations. Persons wholly unqualified for such work have made a practice of presenting plans and trusting to building officials to redraft them in legal form. This practice has resulted in continuous and serious delays in the handling of the city's building operations." This new and officially sanctioned attack needlessly stirs up interprofessional hostilities. If its purport is to lead the public to believe that the multiple-dwelling law protects public safety it is plainly deceptive, for owners may still file plans.

As to the blanket charge against the engineering profession, its unfairness is self-evident. The charge is not borne out by the sworn testimony of the tenement house commissioner of New York City, the respondent in the test case by virtue of his official position, in which he stated: "I know of no evil or abuse arising from engineers as a class filing plans as the agent of the owner, nor do I know of any delay or other matter detrimental to public interests arising therefrom. To the contrary, the department has found that dealing in the first instance with the engineer is most satisfactory to solving the vast majority of questions that arise in the construction of multiple dwellings." Why, then, this attempt by the Institute to lower public esteem for engineers?

Section 300 of the multiple-dwelling law is one of the most obvious pieces of class legislation ever written into law. Many architects deny responsibility for it, and doubtless many of those who have not been active in legislative matters did not know of its existence until it was forced into the limelight this year. But the same cannot be said of architects active in legislative matters, especially those who were members of the committee which drew up the multiple-dwelling law. Nor is it true of the architects who served upon the mayor's committee on revision of the law this year. Albert L. Brockway, a member of the architects' state board of examiners and one of the Institute's most active members in legislative matters, recently made the statement that the architects were as much surprised as the engineers to find this provision written into the multiple-dwelling law. Such being the case, why does the architectural profession strongly oppose its modification?

It cannot be claimed that this section of the law is justified by the state's exercise of police power, because the law permits the owner, who may be completely ignorant of the laws of structural safety or of building design, to file the plan for a multiple dwelling. Architects who have appeared in its support since engineers began testing the law have freely used the hackneyed statement that, if engineers were included, chemical engineers or sanitary engineers or a dozen or more other kinds of engineers unfamiliar with building design would file plans for multiple dwellings. They completely ignore the fact that this has not occurred in the past, and they equally ignore the incompetence of many architects of the pure art variety. Thus they deliberately refuse to credit engineers with the same amount of professional responsibility that they assume for their own profession.

As an entering wedge in a concerted drive to force engineers out of other parts of the building field, the multiple-dwelling law of New York State is of major significance to the architectural profession. So long as the restrictions of section 300 remain on the statute books of New York State, it can be used effectively with legislators in furthering this movement. It was used effectively in Albany this year in the drive to restrict the field of engineering to industrial buildings, power houses, etc. Herein may be found the reason for the American Institute of Architects' active interest.

The broad-minded men of both professions look with disfavor upon the present controversy. It discredits both in the eyes of the public and brings no real advantage to either. The efforts of some of these men to put the two professions back on a basis of mutual respect and cooperation have not been without fruit; but they cannot be expected to be effective so long as the American Institute of Architects continues to give its approval to the attack which some of its members are making upon the engineering profession.

Design and Construction of a 125,000-Ton Rock-Storage Bin

Concrete Structure 460x100 Ft.. in Plan Located on Bank of Canal—Carried on 4,000 Wood Piles 65 to 80 Ft. Long—Pin Connections Make Roof Trusses Independent of Column Movement

WITHIN the past year the United States Gypsum Co. has brought to completion an extensive development program involving among other things the construction of four new manufacturing plants located in the metropolitan areas of Boston, Detroit, Philadelphia and Chicago. The structures required for these plants are of conventional types with the exception of the gypsum rock-storage facilities which present some interesting studies in the use of reinforced concrete for bins. At none of the plants are these storage facilities more unusual than at the Chicago plant, which is located on the Indiana Harbor canal in East Chicago, Ind. Here the gypsum rock is stored in a covered rectangular bin, 460 ft. long, 100 ft. wide and 112 ft. high, to the apex of the steel roof trusses, with a capacity of 125,000 tons. This storage capacity contracts with a capacity of 25,000 tons in five concrete silos 85 ft. high at Boston, with 50,000 tons in two concrete tanks 95 ft. in diameter at Philadelphia and with 80,000 tons in three concrete tanks 105 ft. in diameter at Detroit.

The rock-storage bin at Chicago is in effect a pair of 40-ft. concrete retaining walls, parallel and 100 ft. apart, tied together at the bottom with a series of heavy transverse struts. Along the top of these retaining walls tower-type columns 40 ft. high carry steel roof trusses, which in turn support copper-bearing corrugated steel roofing sheets. The bottom of the bin is paved with a 13-in. concrete slab. The foundation is made up of more than 4,000 wood piles 80 ft. long beneath the walls and 65 ft. long beneath the bottom slab. Special details are incorporated in the steel superstructure to cope with any possible settlement of the retaining walls.

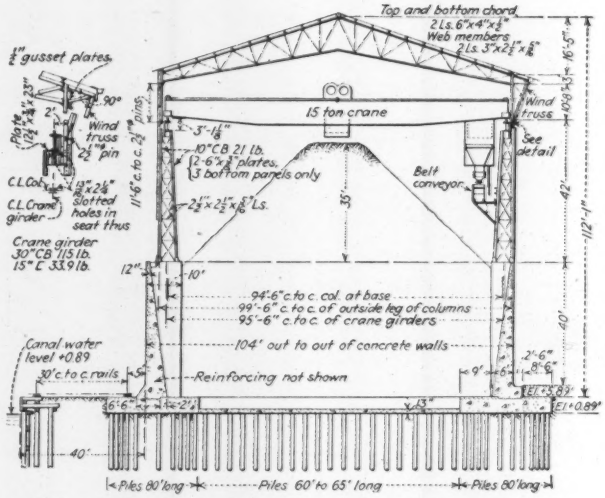

Top and bottom chord, 2 Ls. 6"x4"x⅝" Web members 2 Ls. 3"x2½"x⅜"
1" gusset plates
15 ton crane
Wind truss
See detail
Belt conveyor
Crane girder 30"CB 115 lb. 15" I 33.9 lb.
Canal water level +0.89
30' c. to c. rails
Reinforcing not shown
104' out to out of concrete walls
Piles 80' long
Piles 60' to 65' long
Piles 80' long

FIG. 2—CROSS-SECTION OF 125,000-TON GYPSUM ROCK-STORAGE BIN, EAST CHICAGO, IND.

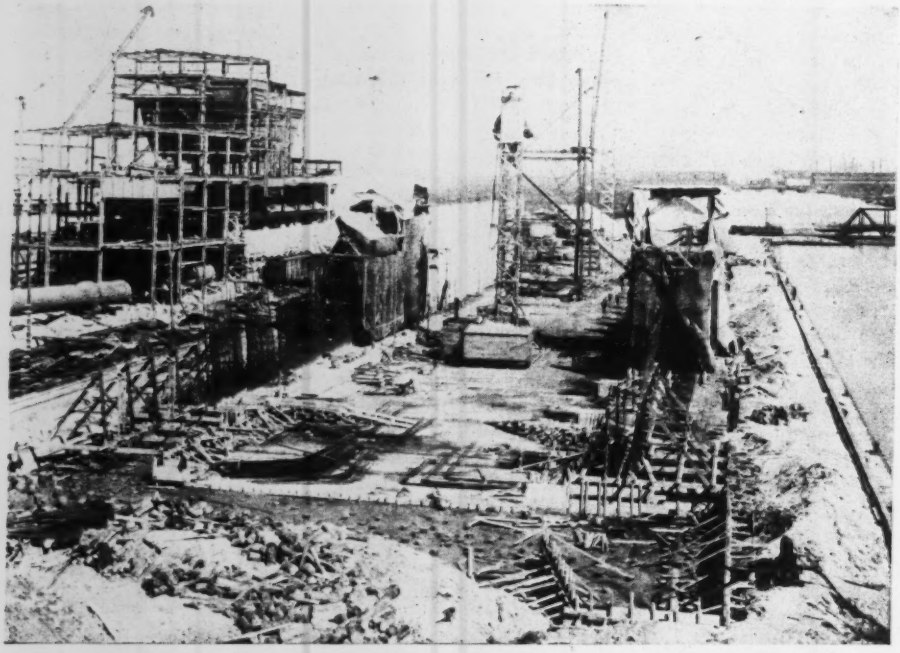


FIG. 1—CONSTRUCTION VIEW OF GYPSUM ROCK-STORAGE BIN

Movable concrete tower from which concrete was chuted into side walls near center of the bin. Moveable steel traveler tower erecting superstructure in background. Note tarpaulins for winter protection Also, supports for reinforcing steel for the walls in the lower right center.

Foundations—Borings showed hardpan at depths of from 80 to 85 ft. below finished grade and revealed bedrock about 10 ft. below the hardpan. Overlying the hardpan was a 20-ft. layer of stiff blue clay, followed by a 40-ft. layer of soft blue clay and topped by a 20-ft. layer of silt and sand.

It was evident that suitable foundations to carry the load of the rock bin, when filled with 125,000 tons of gypsum rock, should go below the soft stratum and probably should rest on the hardpan or bedrock. About 3 miles away an ore dock had failed several years previously because of lateral movement of a layer of soft clay similar to that at the rock bin location. The possibility of a like movement under the bin was seen because of the proximity of

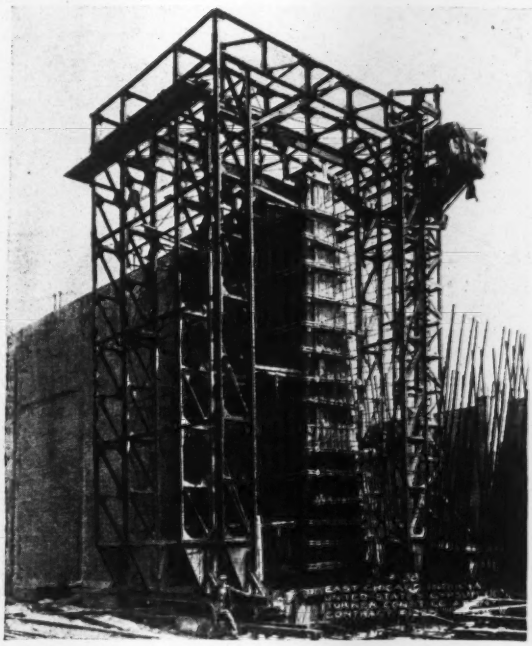


FIG. 3—FORM GANTRY FOR CONSTRUCTING CONCRETE WALLS OF BIN

the Indiana Harbor canal. Although its present depth is only 25 ft., there is a probability that it will be dredged to 35 ft., which dredging would remove nearly all of the lateral support of the soft layer of clay.

The foundations of the rock bin walls, therefore, are carried on piles 80 ft. long driven to the hardpan, each designed to develop a loading of 35 tons as determined by tests. The floor of the bin is carried on piles 65 ft. long, driven well into the stiff blue clay below the soft stratum. The principal function of these piles is to consolidate the earth under the floor of the bin inside the closing ring of 80-ft. piles.

Unusual care was taken in designing the pile foundation under the wall footings. Thus the area was divided into sections of varying and convenient size, and the piles were spaced in these sections by using the moment-of-inertia method. Fig. 2 shows the arrangement of piling under the floor and walls and also illustrates the method of tying the footings and the retaining walls together.

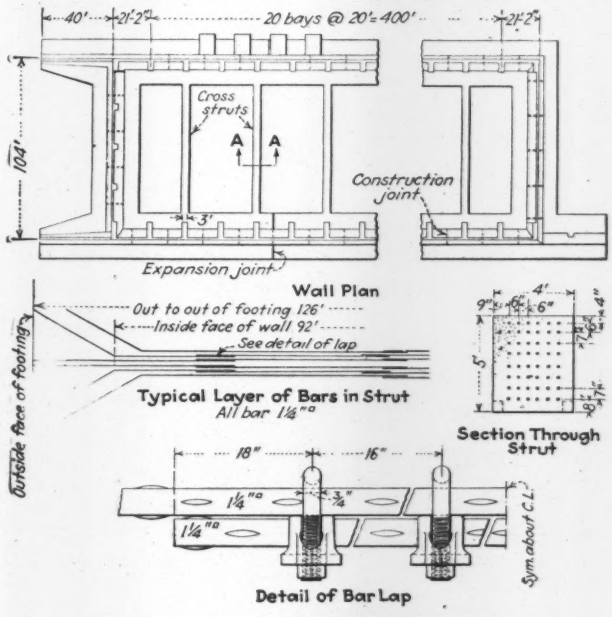


FIG. 4—WALL PLAN AND DETAILS, GYPSUM ROCK-STORAGE BIN

Walls—The walls are of the centilever type with piers at 20-ft. intervals along the inside face to support the superstructure columns. At 40-ft. intervals, or at every third pier, a transverse strut is used to tie the two retaining walls together, as shown in Fig. 4. In designing the cantilever walls, a modification of Rankine's theory

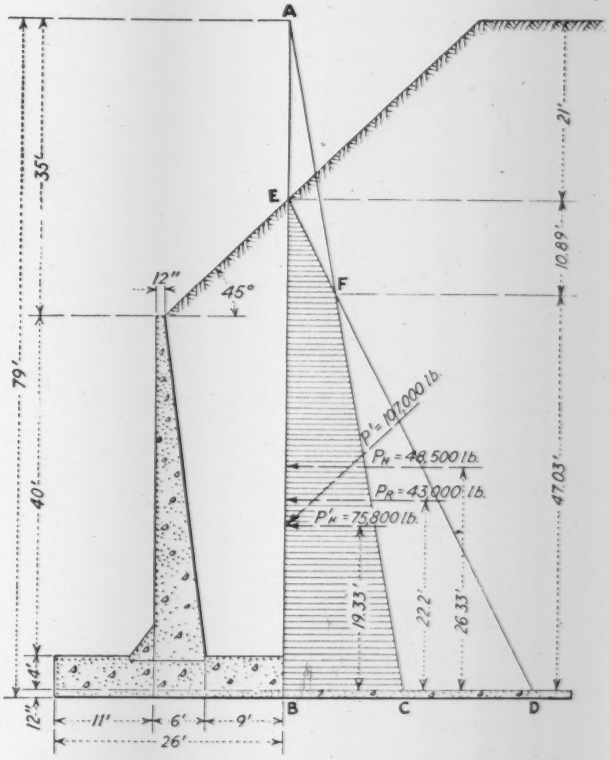


FIG. 5—PRESSURE DIAGRAM USED IN WALL DESIGN
Cross-hatched quadrilateral, upon which design is based, consists of a combination of two pressure triangles, one drawn on the assumption of an indefinite sloping surcharge; the other on the assumption of a sloping discharge 35 ft. high.

of earth pressure on retaining walls was used. The theory recognizes two alternative assumptions—namely, a sloping surcharge of indefinite extent at an angle of 45 deg. with the horizontal; and a surcharge with a horizontal top. In designing the walls of this bin, the two assumptions were combined and a horizontal surcharge with a height of 35 ft. above the top of the wall was specified. The pressure diagram shown in Fig. 5 indicates the method of design by combining the two assumptions. The angle of internal friction of the material was assumed at 45 deg., as was the angle of repose of the material, while the weight of gypsum rock was taken at 90 lb. per cubic foot. Pressure diagrams were drawn for each of the assumed surcharges and then were combined, giving the resulting diagram *EBCF*, shown in Fig. 5. The area *ABC* represents the pressure diagram for a 35-ft. horizontal surcharge and the area *EBD* represents the pressure diagram for a sloping surcharge of indefinite extent. The resultant pressure of *ABC* is P_h, or 48,500 lb., acting horizontally. The resultant pressure

of *EBD* is *P'*, or 107,000 lb. acting at 45 deg. with horizontal, or parallel to the surface of the surcharge; its horizontal component is 75,800 lb. The resultant overturning pressure of the combined pressure diagram *EBCF* is therefore P_R, or 43,000 lb.

Inclosing Superstructure—The superstructure, shown in Fig. 6, is composed of two-leg tower-type steel columns spaced at 20-ft. intervals along the wall carrying steel roof trusses and a crane runway. The columns are 41 ft. high to the base of the crane rail. In order to secure clearance for the 15-ton overhead crane, the roof trusses are raised 11½ ft. above the top of the tower columns by means of short columns of a T-section made up of two 6x6-in. angles. In the design of this steel superstructure some settlement was anticipated at the toe of the walls. This settlement was assumed to be a maximum of 2 in. at the bottom, which would make it 9 in. at the top. Since the steel columns were assumed fully fixed at the base, provision was made at the crane girder seat for an adjustment of 9 in., so that realignment could be made in the crane rails. This 9-in. adjustment is made by means of sliding plates.

Any settlement would also affect the roof trusses. To make them independent of any lateral movement of the supporting columns, the trusses, including the short column supports, are designed as three-hinged. Thus 2½-in. diameter pins are used at both the top and the bottom of the short column sections on one side and at the bottom on the opposite side. Inasmuch as any lateral movement produced by wind will cause bending in this short column, it is reinforced by means of a small knee-brace truss as shown, which truss transmits roof wind loads into the main columns below.

Construction—In addition to the features of design, the construction methods used on this bin are of interest. High winds and cold weather, with temperatures as low as 10 deg. below zero, complicated the work. For pouring the mass concrete in the side walls two structural steel traveling gantry forms mounted on rails were used. The forms were 20 ft. long and permitted pouring the wall in 20-ft. sections for the full 40-ft. height. The concrete tower was also built as a movable unit running on rails placed along the middle of the bin as shown in Fig. 1. Concrete was transported in 1-ton trucks from the central concrete plant to a hopper at the base of this tower, where it was elevated and spouted to the wall forms.

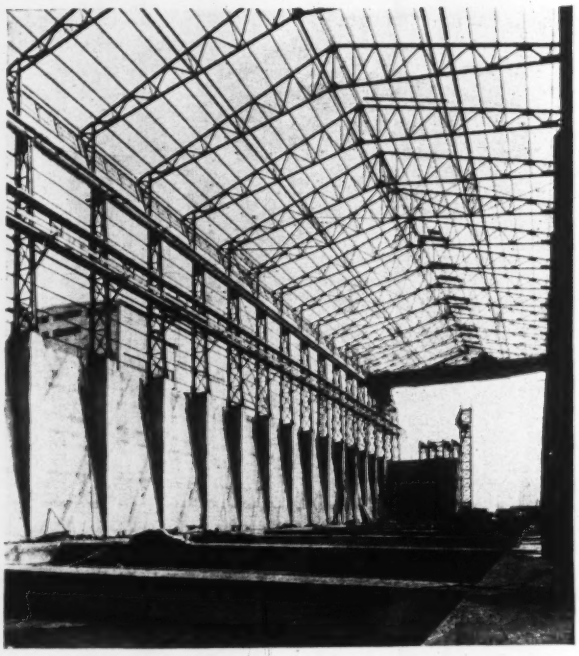


FIG. 6—GYPSUM ROCK-STORAGE BIN NEARING COMPLETION
Note heavy transverse struts tying walls together at base. The wind truss on the outside of the stub column above the crane runway may be seen.

In order to cope with the cold weather, a 20-hp. steam boiler mounted on a sled was drawn along by means of a hand winch as the work progressed. Steam hose was run from this boiler into the forms to thaw the ice or snow, after which the reinforcing was placed. The framework that supported the bars was covered with tarpaulins, and salamanders placed at the bottom of the

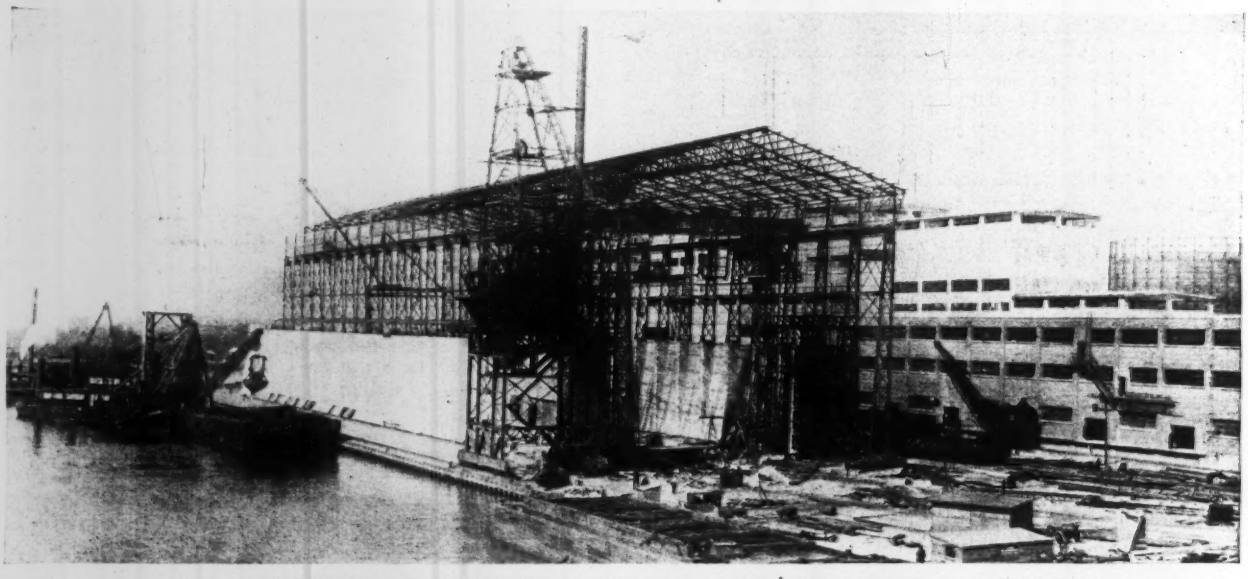


FIG. 7—ROCK-STORAGE BIN BEFORE ROOF AND SIDE SHEATHING WERE IN PLACE
Note unloader for transferring gypsum rock from boats into bin.

footing were kept under full fire throughout the night. The following day concrete was poured. By opening up the tarpaulins at one end of the footing section, concrete trucks were able to back under the tents to dump their loads. With the footings poured, the salamanders were distributed and the completed area inclosed with tarpaulins.

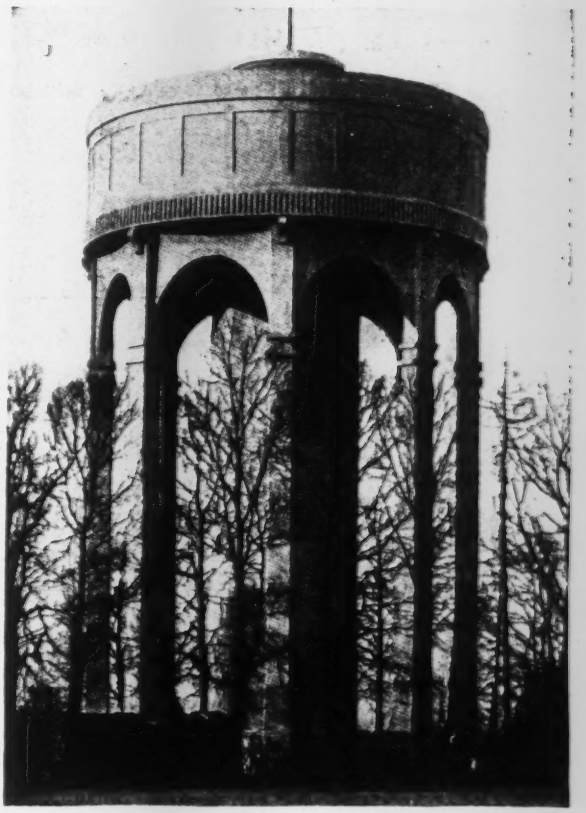
The side wall concrete forms were also completely inclosed with tarpaulins and as many as 30 salamanders were kept hot inside. Of the 15,000 cu.yd. of concrete in the walls, 80 per cent was poured when winter weather protection was necessary.

Progress on the wall construction was rapid, one section being poured in one day, the forms stripped on the second day and a third section poured on the third day. Considering both of the walls, this permitted five wall pours per week.

As an aid in spouting the concrete from the tower to the walls, a 1¼-in. steampipe was turned into the hopper at the top of the tower. Another branch of the steam line ran into a flexible hose, and this was used in clearing the spouts when they became clogged.

A 40-hp. boiler was also used in the central mixing plant for heating water and for supplying steam to coils in the sand and gravel hoppers. Also, the sand and gravel siding was inclosed and salamanders were placed at track level along each side of the cars to keep the sand and gravel from freezing.

The East Chicago plant was designed and constructed by the U. S. Gypsum Co. under the direction of J. H. Nold, chief engineer, and staff. The plant was built by the Turner Construction Co. under the direction of J. P. H. Perry, vice-president.



REINFORCED-CONCRETE WATER TANK AT HERTFORD, ENGLAND

Eight columns and large octagonal central access shaft support a 240,000-gal. covered tank. View reproduced from the London *Surveyor*, March 21, 1930.

Unusual Elevated Water Tank at Hertford, England

Appearance Put First in Design for Structure in Residential District—Tank Has Two Independent Compartments

AN ELEVATED tank which is unusual both for the attention given to its appearance and for the division of the tank into two independent storage units was completed recently as an extension to the water-works of Hertford, England. Location of the tank on high ground in a residential section of the borough is given by the London *Surveyor* of March 21 as the reason for putting appearance before cost, and also for choosing the design adopted, even though more costly than others that were submitted after the borough surveyor had been "instructed to obtain designs from a few ferro-concrete engineers."

The tank and supporting tower are of reinforced concrete. The tank has a capacity of 240,000 gal. (U. S. measure). A concentric partition wall divides the tank "into two approximately equal parts," the "partition being designed to take the full head—15 ft. 3 in.—so that each tank can be independent." (The article from which these notes were taken does not state the object of dividing the tank into two parts.)

The floor of the tank is 75 ft. above the ground level and is supported by eight columns and a large central "access shaft." The columns are 3 ft. square except at the base, where they are 4 ft. square. The central shaft is octagonal, 17 ft. 10 in. across, its sides being parallel with the arches between the columns. The tank floor is supported by beams. In the center of the tower there is continuation of the access shaft, but it is much smaller—6 ft. 3 in. square. A stairway and the pipe connections are within the access shaft, as are also two platforms, one about 27 ft. and another about 64 ft. from the ground.

The contracted upper portion of the access shaft is covered by a cupola and the whole tank by a roof which slopes a little toward the cupola.

The floor of the tank is 5½ in. thick. The tank walls have a minimum thickness of 4 in. The access shaft through the tank has 5½-in. walls, but the larger main shaft below has 4-in. walls, with stiffening rings and crossbracings every 9 ft.

The pumping and delivery mains are 10 in. in diameter to a point just below the upper platform, where branches lead to each tank, the branches being controlled by valves operated from the platform. Washout and overflow pipes are provided. All these vertical pipes have flexible joints to provide for expansion and contraction.

Foundations for the columns and the access shaft are carried down about 9 ft. to a bed of gravel.

The tank and tower cost "upward of £7,000 (about $35,000). The design chosen was that of L. G. Mouchel & Partners, Ltd., Westminster, S. M., who served "as consulting engineers in collaboration with the borough surveyor, S. M. Senior."

Conservancy District on the Rio Grande

Ten Million Dollar Project in New Mexico Includes Flood Control, Irrigation, Drainage of Seeped Lands, River Regulation and Silt Control—Contract and Force-Account Work Combined—Rockfill Storage Dam—Diversion Dams and Headworks

By Lee Noftzger
Civil Engineer, Albuquerque, N. M.

FLOOD CONTROL, irrigation and drainage are included in the project of the Middle Rio Grande Conservancy District for the development of a tract of 123,267 acres in central New Mexico lying along both sides of the Rio Grande and extending from White Rock Canyon to San Marcial, a distance of about 150 miles. Congress has authorized an appropriation of $1,593,000 on behalf of Indian lands in the District, and the district has contracted for the sale of $5,000,000 bonds out of an authorized bond issue of $8,744,000. A suit over the validity of the bonds ended on Sept. 10, 1929, with a unanimous decision by the state Supreme Court in favor of the district.

This project is not a development of new land, since it has substantial assets and a present population of 55,000, so that its success is not dependent upon land sales and colonization. It is primarily a conservation and restoration project to protect 10,000 homes and $40,000,000 worth of farms and industries from damage by seepage and floodwaters.

The Middle Rio Grande Valley, lying at an elevation ranging from 4,460 ft. at San Marcial to 5,200 ft. at Cochiti, is flanked on both sides by hills at distances of 3 to 10 miles. Through this fertile valley of rich alluvium the river flows in a sinuous course and has a wide, shallow and unstable channel. The valley is one of the oldest sections of the country, is the most densely populated section of New Mexico, and is an agricultural oasis isolated by vast areas of non-arable grazing lands, but having excellent railway facilities.

Reclamation Problem—For more than 200 years the valley has been irrigated without restraint, regulation or drainage. River seepage, irrigation and flooding have converted it into an alkalied, swampy and waterlogged area; 70 per cent of the land has groundwater level at or within 4 ft. of the ground surface. Increasing diversions from the upper Rio Grande have lessened river discharge, velocity and silt-transporting capacity through the Middle Valley, while accelerated erosion along the tributaries has greatly increased deposition of silt and sand. All this has altered the natural regimen of the river, widened the channel through the easily eroded alluvium, and raised the bed 2 to 4 ft. above the lowest valley lands.

Flood flows of 15,000 to 30,000 sec.-ft. are not uncommon, though the average channel capacity is only about 12,500 sec.-ft. In 1874 the Albuquerque area was visited by a disastrous flood, estimated at more than 60,000 sec.-ft. (from a drainage area of 17,000 square miles). The business district of this city of 35,000 population occupies the flood channel of 1874 and is protected by an inadequate dike. At times, however, the river is far below irrigation requirements. Great fluctuations occur in annual flow and seasonal distribution of flow. About 70 per cent of the annual flow occurs during April, May and June; during the late summer the river is usually dry as far up as Albuquerque. In the lower end of the valley, water shortage is frequent and acute.

The principal features of the project are here briefly outlined:

1. *Water Storage*—Storage for irrigation and for partial regulation of flow will be accomplished by a dam on the Rio Chama, about 175 miles north of Albuquerque.

2. *Flood Control*—Levees will provide flood channel capacity of 40,000 sec.-ft. near Bernalillo, increasing to 60,000 near San Marcial, with extra height of levees to secure safe passage for about 75,000 sec.-ft. at Albuquerque.

FIG. 1—WHITE ROCK CANYON, N. M.
Head of Middle Rio Grande Conservancy District.

3. *Water Supply and Drainage*—Additional water supply for irrigation will be obtained by saving the water now lost through evaporation from seeped areas. Groundwater will be lowered by drainage to a depth at which it cannot be depleted by excessive evaporation.

4. *Irrigation*—Four diversion dams on the Rio Grande and a system of canals and laterals will provide for irrigating 123,267 acres.

5. *River Improvements*—Jetties or retards of the permeable type, submerged during high water, will protect the levees and regulate deposition of silt. They will create a narrow, well-defined low-water channel.

6. *Silt Control*—Erosion along tributaries and silt deposition in the river will be combated by planting grass, shrubs and trees, and by constructing small check dams across *arroyos* or creeks.

Indian Lands—The project is complicated by the inclusion of Indian lands within the conservancy district, these being divided into six separated portions interspersed with private lands. Six tribes hold land with a total irrigable and benefited area of 21,888 acres, of which only 8,346 acres partly and crudely irrigated by the Indians. The land produces barely sufficient crops for the owners and no income. All of these lands need improvement and are subject to almost equal benefits under this project, but the federal law makes the so-called irrigated area of 8,346 acres exempt from assessment by the district for operating, maintenance and betterment expense, while the water rights of that area are declared prior to those of the district.

FIG. 2—RIO GRANDE NEAR ALBUQUERQUE
Showing jetties and emergency bank protection.

In 1928 Congress appropriated $1,593,111, or a maximum of $67.50 per acre, for irrigation, drainage and flood-control works on Indian lands within the district. In accordance with the law, the secretary of the interior executed a contract with the Middle Rio Grande Conservancy District on Dec. 14, 1928, thus insuring 21,888 acres of productive and income-earning lands. As the Indian holdings constitute about 18 per cent of the irrigable land, it would not have been possible to carry out the project without the participation of these lands and the federal appropriation.

Combination Force Account and Contract—About 24,000,000 cu.yd. of excavation will be involved in the canals, laterals, drains, levees and river improvements. After careful study it was decided that a combination of force-account and contract work would be the most satisfactory, because the excavation program must be subject to revision to meet exigencies as they arise. As the construction program covers a period of five years, it is essential that all excavation be completed within four years. This work will be complicated by the existence of 67 independent community ditches, which must be kept open during the progress of the work and gradually incorporated, wherever possible, into the district system. Location of levees and riverside drains will depend upon the results accomplished by the jetties in filling bends and straightening the channel and upon the development of "piping" and "sand boils." As most of the drain excavation will be in saturated silt and sand, the sections and grades of the drains cannot be predetermined exactly.

When there is probability of change in location, plan or design of drains, river improvements or structures, and when canal excavation will be complicated by irrigation operations, the work will be done by the district with its own forces. The El Vado dam, the largest main canal, concrete-pipe work, and many other features can probably be done more advantageously by contract. The district has purchased twelve diesel drag-lines, four with 1½-yd. buckets on 60-ft. booms and eight with 1¼-yd. buckets on 50-ft. booms. These machines are equipped with special crawler tractions, which reduce the load to less than 1,300 lb. per square foot of bearing area.

Appraisal of Property—A colossal preliminary was the surveying of 11,300 tracts of agricultural property and the inspection, classification, and appraisal of 23,600 parcels of property. Benefits and damages were influenced by irrigation, drainage and flood control, so that it was necessary to evaluate the effect, both individually and collectively, of the three proposed improvements. However, there were only five appeals from the awards of the appraisers.

Surveys and Studies—Field surveys were begun in June, 1926, and the official plan was filed May 3, 1928. All agricultural land other than Indian, consisting of 11,300 small and irregular tracts, totaling 100,533 acres, was surveyed and mapped on a scale of 200 ft. to the inch on sheets 33x66 in. Each sheet was designated as a block and each block and tract was numbered. Reference to these numbers is a legal description.

The 11,300 small tracts are the result of innumerable transfers of titles and subdivisions of the original Spanish land grants. At each change of ownership the original tract was divided, and this process has continued throughout ten generations. No surveys or plats were made and descriptions of boundaries were usually vague and indefinite. Ownership claims were frequently conflicting. Including town and city property, 23,600 tracts were inspected, classified and appraised.

Six reservoir sites have been surveyed, including extensive foundation-testing and geological investigations. Comparative designs and estimates were prepared for eighteen storage and flood-detention dams. Water-supply studies, carried on since June, 1926, consisted of the installation and care of a soil-evaporation station (Fig. 4), monthly groundwater measurements of 1,000 test wells, stream gaging and silt sampling. Studies and investigations of flood protection, drainage, irrigation and river improvement have been made and plans and estimates prepared.

Conservancy Law—The New Mexico law under which the district is organized closely follows those of Ohio and Colorado, except that it covers irrigation and drainage, whereas the others include only flood control. This application of the conservancy type of law is unique and has resulted in wide distribution of costs.

The district, a municipal corporation, is governed by a board of five commissioners who hold office for six years. They are appointed jointly by the judges of the two judicial districts lying within the boundaries of the district. The law provides for the issuing of bonds, which are a lien against all benefited property (except Indian lands), to the extent of the benefits appraised against the property. A board of three appraisers, ap-

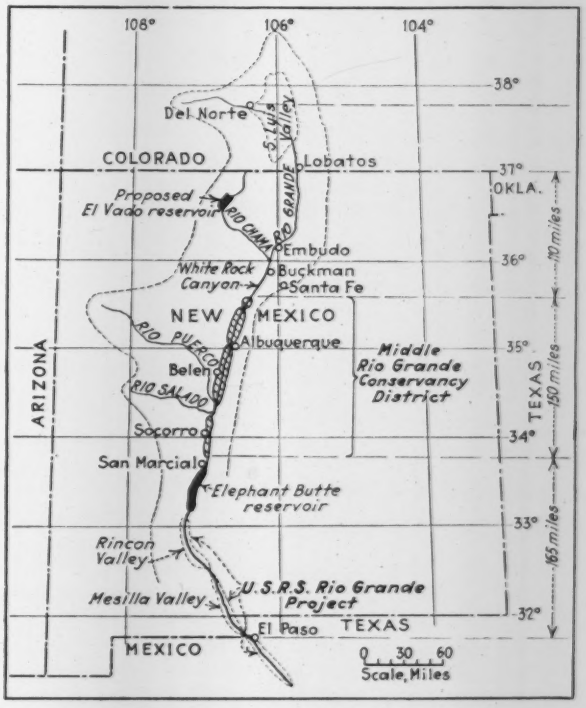


FIG. 3—THE RIO GRANDE VALLEY, N. M.

FIG. 4—SOIL EVAPORATION STUDIED AT THIS STATION SUPPLIED DATA FOR PROJECT

pointed by the court, appraised benefits and damages to all affected property.

The principal towns in the district are Albuquerque, Belen, Socorro, Bernalillo and Los Lunas, with populations ranging from 35,000 to 1,000. The district's total population is 55,000, including 3,000 Indians. Its assessed valuation is $40,000,000 on a basis of 50 per cent of actual value, of which $20,000,000 is in Albuquerque.

Rainfall and Floods—At Albuquerque, the 40-year mean rainfall is 7.59 in. At Socorro, the 28-year mean is 11.09 in. The mean annual temperature is 55.7 deg. F., with a mean maximum of 70.1 and a mean minimum of 41.6 deg. The average growing season is 190 days. Annual precipitation varies from 8 in. in the valley to about 24 in. along the upper tributaries.

The greatest measured flood occurred in October, 1904, with 33,000 sec.-ft. at San Marcial, from a drainage area of 26,696 square miles. The maximum recorded spring flood was at San Marcial in May, 1905, with 29,070 sec.-ft. The maximum recorded flood at Buckman, drainage area 13,914 square miles, occurred in May, 1920, with a discharge of 38,800 sec.-ft. Eight of the ten recorded floodflows in excess of 12,500 sec.-ft. occurred in the spring and were due to melting snow in the mountains. Two occurred in October and were caused by storms on the tributaries below Buckman. Under favorable conditions any one of the Rio Grande's five main tributaries, with drainage areas varying from 769 to 5,170 square miles, could be responsible for a floodflow of 100,000 sec.-ft. or more.

Probability studies for both flood peaks and runoff have been made for stations on the Rio Grande, Rio Puerco and Rio Chama, with the following conclusions: (1) These studies may be of some value in extending a short-time discharge record, provided that record contains either very high or very low terms or both; (2) for the Rio Grande and Rio Chama stations, with records of 33 years, probability methods are of more value in determining minimum streamflow expectations than as a guide to maximum flood peaks; (3) the high or low flow is not a matter of chance, but in this valley depends largely upon the time and distribution of the mountain snowfall and the melting of that snow in the spring.

At Buckman, the average annual flow of the Rio Grande for the 33-year record is 1,428,000 acre-ft., with variations from 425,000 in 1902 to 2,359,000 in 1920. Seasonal distribution of the average flow varies from 42,800 acre-ft. during January to 400,000 during May. The distribution of flow shows the necessity of storage for regulation, and the large variations in annual flow indicate the necessity for hold-over storage.

Drainage Ditches and Water Supply—An unusual and important feature of the plan is that open drains will save more than sufficient water, by reducing evaporation from seeped areas, to supply the district's additional requirements for irrigation. This reclaimed water will be made available by direct diversions from the Rio Grande, augmented by water from the reservoir on the Rio Chama. The main ditches will parallel the levees.

Headgate diversion to the lands is assumed at 4.5 acre-ft. per acre for the irrigation season, March through October, with net delivery of 3 acre-ft. per acre. The estimated drainage return, March through October, based on data from the Mesilla Valley, is 1.85 acre-ft. per acre of irrigated land. Of the 286,000 acre-ft. of water recovered by the drainage system annually, about 191,000 acre-ft. will be available for irrigation.

Drains are expected to be effective for ½ to ¾ mile on each side. For carrying capacity, including river seepage, they are designed as follows: riverside drains, 2.5 sec.-ft. per mile of drain; interior drains near foot of side hills and below canals, 1.75 sec.ft.; other interior drains, 1.5 sec.-ft. Riverside drains will be 6 to 8 ft. deep, with 10- to 20-ft. bottom width. Interior drains will be about 10 ft. deep, with 8- to 14-ft. bottom.

Levees—By means of levees a floodway width of 1,200 ft. at the upper end, gradually increasing to about 1,500 ft. at Albuquerque and 2,000 ft. below the Rio Puerco, will be created. Their general height will be 8 to 9 ft. above ground surface, and their Crown width 8 to 10 ft. Slopes will be 1 on 1½ on the land side and 1 on 2½ on the river side. Protection against erosion will be provided where necessary, and bends and curves will be protected by jetties and other works.

El Vado Dam and Reservoir—Storage of 198,000 acre-ft. for irrigation and partial regulation of river flow will be provided by a dam in a narrow gorge through sandstone and shale formation on the Rio Chama, near El Vado. Its site is shown in Fig. 5. Except for the shattered condition of the east abutment this site would be ideal for a concrete arch dam. The steep face of the east abutment breaks at a height of 100 ft. and then extends in a slope, but the west abutment is continuously steep.

This dam will be a gravel and loose-rock embankment, with a height of 175 ft. above bedrock, a length of 1,300 ft. at the crown and a bottom length of 140 ft. Its crown width will be 20 ft., and maximum width of base 600 ft. The upstream face will have a slope of 1 on 1¾ and the lower face 1 on 1½. On the upstream slope will be a reinforced-concrete face 8 in. thick at the top and 13 in. at the bottom, where it will join a concrete cutoff wall extending to bedrock and reinforced on both sides to insure against cracking in case of settlement of the shattered rock in the east abutment. The bedrock below the wall will be grouted under pressure through drill holes. Two spillways will give a combined capacity of 60,000 sec.-ft., the second or emergency spillway (50,000 sec.-ft.) being in a saddle about a mile west of the dam. Above the dam the drainage area of the Rio Chama is 650 square miles. The average annual runoff is 310,000 acre-ft. and the maximum recorded discharge is 5,000 sec.-ft. This reservoir will provide storage at a cost of about $8 per acre-foot of water stored.

Diversion Dams—Four diversion dams on the Rio Grande will serve six main canals. The Cochiti dam is to be a concrete ogee weir structure founded on heavy gravel; crest length, 300 ft.; height, 7 ft.; total width of base slab, 80 ft. Diversion works at the west end consist of two concrete conduits to the canal, controlled by two slide gates 3.6x4.5 ft., and a sluiceway

through the dam controlled by a radial gate 10x7 ft. This dam is designed to divert 200 sec.-ft.

The Angostura dam will be a low, flat weir on sand and gravel; total length 938 ft., including sluiceway. The river section will be of loose rock, held in place by sheetpiling and concrete walls, the top slope being paved with hand-laid stone. This section is 520 ft. long; maximum height, 6 ft. above riverbed; base width, 70 ft. The central section, with pile foundation and located on a gravel bar, is to consist of a sloping concrete deck, with sheetpiling at the crest and toe. The sluiceway section at the east end will have five openings, 20 ft. wide, controlled by radial gates 20x6.4 ft. A concrete floor will extend 57 ft. upstream and 40 ft. downstream from the gates. A skimming weir 149 ft. long will exclude the heavier sand and gravel from the canal, which is regulated by one radial gate, 20x6.4 ft., set about 150 ft. downstream from the weir. These headworks are designed to divert 550 sec.-ft.

FIG. 5—SITE OF EL VADO DAM, ON RIO CHAMA

The Isleta dam will be a flat-crested concrete slab 692 ft. long, terminating at each end in a sluiceway 127.5 ft. long. The foundation is silt and sand, requiring round and sheet piling. This dam is designed to divert 300 sec.-ft. at the east end and 1,000 sec.-ft. at the west end. The concrete slab forming the crest is 40 ft. wide and its downstream toe will be protected by a blanket of heavy riprap 20 ft. wide and 5 to 10 ft. thick. Each sluiceway is controlled by six radial gates 20x6.4 ft. The headworks at the ends of the dam are 170.5 and 84.5 ft. long, designed to exclude the heavier sand and gravel from the canals by skimming the surface of the stream. Radial gates will control the flow in the canals.

The San Acacia dam will be a weir with 30 radial gates 20x6.4 ft., located in a gorge, but the silt and sand formation will necessitate piling and sheetpile cutoffs. It will be 643.6 ft. long, with a base 18 ft. wide for the pier section supporting the gates. Concrete aprons will extend 60 ft. upstream and 18.6 ft. downstream, with a blanket of loose rock, 20 ft. wide, at the downstream edge. The counterweighted gates will be operated by hoists from a concrete deck, supported on piers. Headworks at the west end, with a skimming arrangement to exclude sand and gravel, will control the intake to the canal, which has a capacity of 276 sec.-ft.

Irrigation Ditches—The existing small ditches were constructed at different times, with no thought of forming a part of a system. The project calls for six main canals, with capacities ranging from 170 to 1,000 sec.-ft. and a total capacity of 2,500 sec.-ft. Their total length will be 152.7 miles, requiring 4,176,531 cu.yd. of excavation, while 356.3 miles of laterals will require 2,213,155 cu.yd.

For areas which can be reached only by carrying laterals across the river, there will be five reinforced-concrete inverted siphons 1,200 ft. long and 40 to 72 in. in diameter. Numerous bridges, flumes and drops will be required for roads, drains, canals and railroad crossings.

Silt Control—As the Rio Grande carries a high proportion of silt and the amount increases markedly below the mouth of the Rio Puerco, jetties are to be built inside the levee lines to define a narrow low-water channel through which there will be sufficient velocity to scour the bed and prevent further silting. Excessive erosion on the Rio Puerco drainage area will also be checked, preventing the delivery of a large proportion of silt in the Rio Grande. Erosion along tributaries has been greatly accelerated during recent years, due to a reduction of vegetation.

The Rio Puerco is responsible for 40 per cent of the 9,000 acre-ft. of silt now entering Elephant Butte reservoir annually, although its drainage area comprises but 20 per cent of the total Rio Grande drainage area. Grass, trees and shrubs will be planted along the Rio Puerco and its tributaries to prevent side erosion, and small check dams will be constructed across *arroyos* and washes to retard movement of silt and sand. With the funds provided, only a start can be made on this work.

Summary of Cost—The total estimated cost of $10,337,000 is distributed as follows: El Vado dam and appurtenances, $1,481,863; canals, laterals and diversion dams, $3,484,562; levees and drains, $2,390,710; flood control and river improvements, $1,646,007; silt control on tributaries, $95,195; water rights, $80,000; permanent improvements, telephone system, etc., $50,000; preliminary expenses, $325,000; field engineering, $315,878; administration and legal expenses, $467,785.

Engineers—Joseph L. Burkholder is chief engineer of the Middle Rio Grande Conservancy District, and the Dayton-Morgan Engineering Co., Memphis, Tenn., acts as consulting engineer. The official plan was approved by a board of engineers consisting of D. C. Henny, Arthur E. Morgan and W. M. Reid. For that part of the work which will be on Indian lands, the plan was approved also by Gen. H. F. Robinson, supervising engineer of the U. S. Indian Bureau.

Formulate Procedure for Purging Gas Holders

In a code of recommended procedure for purging and placing gas holders in service or removing them from service, recently drawn up by a committee of the American Gas Association, the principle of using an inert gas as intermediary in the replacement of combustible gas by air or vice versa is adopted as basic. Sources of inert gas are discussed, and methods of applying it and venting the holder are set forth in detail. A second principle of safety on which the code rests is the doctrine that all gas piping should be physically disconnected from the holder by blank flanges during the period that the holder is out of service or when it is being purged, so that safety is not dependent on the tightness of shut-off valves. The association has adopted the code, but the committee has been reappointed, and the recommended procedure may therefore be further elaborated in the course of time. J. B. Klumpp, of Philadelphia, is chairman of the committee.

Welding Procedure on Two Steel-Deck Roofs

TWO buildings on which the comparatively rare procedure of connecting steel-deck roofs to the structural frame by arc-welding was successfully tried have recently been completed. On one of these, ordinary flat-rolled sheets comprised the roofing plates, while on the other special ribbed-deck units were used.

The roof of flat-rolled sheets was used on a mill-type building erected at the plant of the Youngstown Welding Co., Youngstown, Ohio. The structure is 140 ft. long and is composed of a main bay 30 ft. wide and a side bay 20 ft. wide. According to A. F. Davis, of the Lincoln

FIG. 1—ARC-WELDED ROOF OF FLAT-ROLLED SHEETS
Frame of building is also welded. Roof of crane bay, at right, similar to one shown.

Electric Co., who furnished this information, the frame and overhead traveling crane, as well as the roof, are welded. The roof consists of 12-gage steel plates, arc-welded into place on bar joists running longitudinally through the building, as shown in Fig. 1. The plates overlap by 1 in., the lower plate being tack-welded to the joist while the overlapping plate is attached by a continuous bead, to make the roof watertight.

The other welded roof is on a new building at the plant of the Babcock & Wilcox Tube Co., Beaver Falls, Pa. According to the Detroit Steel Products Co., whose special copper-bearing steel-deck roof was employed and whose subsidiary, the Fenestra Construction Co., erected the roof, there were 99,700 sq.ft. of roof welded to the

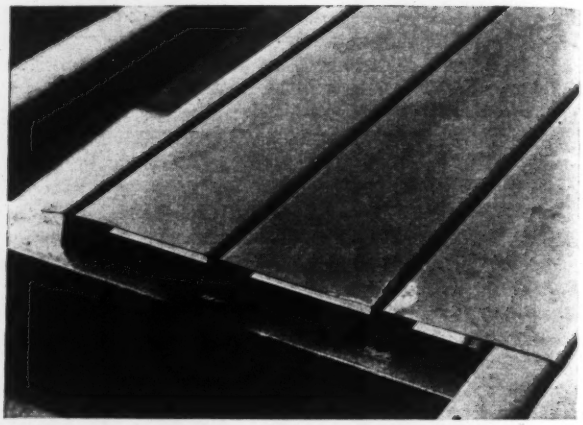


FIG. 3—WELDED ATTACHMENT OF SPECIAL RIBBED-ROOF DECK
Only two center ribs of each unit were welded, the outside ribs being left free to accommodate contraction or expansion movements.

purlins at a speed comparing favorably with that maintained by the older method of clipping. On this structure 1,000 squares of roof deck were laid in sixteen working days, utilizing two motor-generator sets and twenty men. This speed was said to have been made possible by fastening the end of each sheet at the base of the middle two ribs, (each unit comprising four ribs), the other end being telescoped 3 in. into the preceding unit. This method of attachment is shown in Fig. 3. All welds were painted before being covered by the 3-in. lap of the succeeding unit. The sheets at the eaves were the only ones where it was necessary to weld both ends.

By welding the center ribs of each deck unit, it was found that the roof had sufficient strength to withstand an inside pressure of 85 lb. per square foot, while the telescoping end laps supplied adjustability to absorb expansion, contraction or vibration in the frame. The steel decks were covered with ½ in. of insulation and three plies of asbestos waterproofing felts. All welding was done from the top. The McClintic-Marshall Co., Pittsburgh, had the general contract for the building.

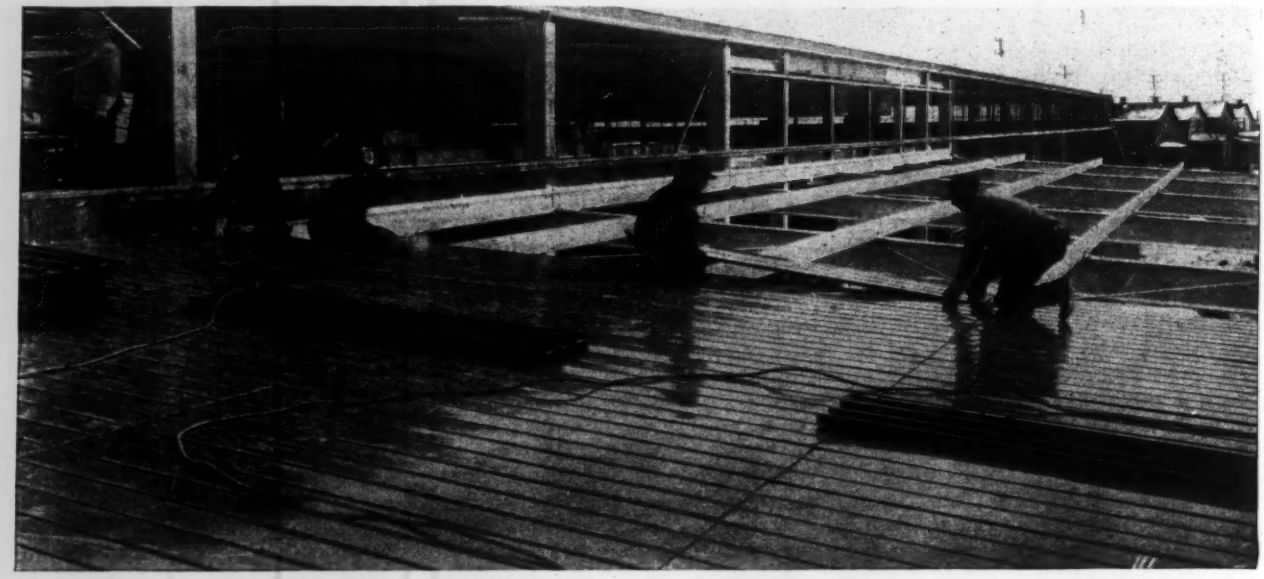


FIG. 2—PART OF 100,000 SQUARE FEET OF WELDED ROOF DECK

High Viaduct 3 Miles Long Will Complete Gap in Holland Tunnel Road

Highway Crossing of Passaic and Hackensack Rivers and Meadows Calls for an Elevated Steel Structure Costing Nearly Twenty Million Dollars

A STEEL viaduct and high-level bridges across the Hackensack and Passaic rivers is the finally adopted plan for the trunk highway which is to take the Holland tunnel traffic across the present gap between the completed viaduct and subway section of this road in Jersey City and the completed section through Newark toward Elizabeth. A general description of the route and tentative plans for the road structure between Jersey City and Newark, and of the completed road structure in Jersey City, was published in *Engineering News-Record*, Jan. 3, 1928, p. 4. The Jersey City-Newark gap at that time was in process of consideration and negotiation with the U. S. Army Engineers and the state authorities over navigable waters in regard to type and design of the river crossings. The present plan described here is the culmination of these negotiations and of the continued engineering studies of the New Jersey Department of Highways.

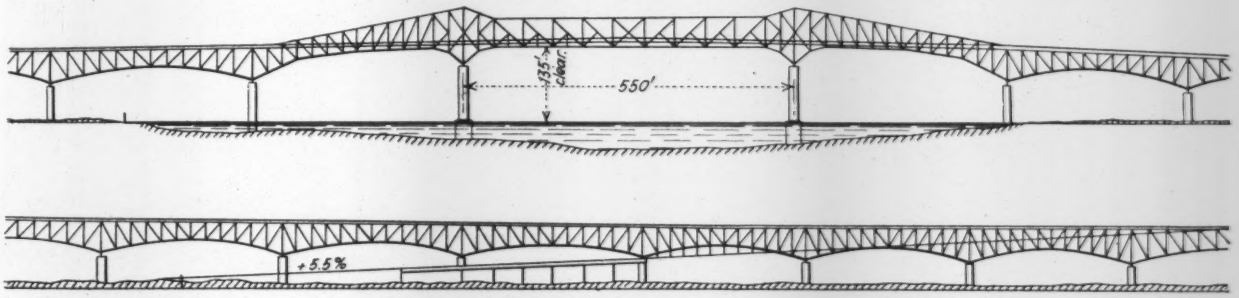
At the present time there are only two highway crossings over the Hackensack River, both low-level swing bridges with clearances of approximately 12 ft. In planning the new connection it was considered essential to provide a third independent crossing, both to relieve congestion and to provide a safeguard in case of accident to one of the bridges, a contingency which has already occurred several times. As originally planned, this new road, officially known as Route 25, crossed the two rivers by lift bridges with a minimum clearance of 35 ft. Although bridge openings would have been less frequent than with the present low-level bridges, there would still have been considerable delay to traffic. Furthermore, when these plans were submitted to the U. S. War Department, they were approved with the condition that the new bridge over the Passaic River be placed adjacent to the present Lincoln Highway bridge and that the old Lincoln Highway bridge spanning the Hackensack should be removed within a three-year period and a tunnel substituted.

Accordingly, the situation was restudied, three possible solutions being considered. These were: (1) the plan already approved, with the vehicular tunnel under the Hackensack River for local traffic; (2) an independent route for the new highway with tunnels under the two rivers connected by a deep open cut; and (3) an independent route with high-level fixed-span bridges having a clearance of 135 ft., connected by a viaduct. The two latter plans would leave the present bridge status unchanged. Preliminary plans and cost estimates were prepared for each of these proposals. Construction costs, including real estate expense, were estimated as follows: plan 1, $20,310,000; plan 2, $21,414,000; plan 3, $19,625,000. Estimates of comparative annual costs of operation, including maintenance of structures and machinery, operation of machinery, lighting and policing, and depreciation, were: plan 1, $356,800; plan 2, $468,300; plan 3, $398,300. Estimates of the annual costs of vehicular operation, comprising items of distance, rise and fall in grade, and delays due to bridge operation, also favored the high-level plan, the comparative figures being as follows: plan 1, $1,172,000; plan 2, $810,000; and plan 3, $760,000. In addition, it was considered that motorists would favor the high-level project because of the elimination of delay at the river crossings and also on account of the greater satisfaction of riding in the open, rather than in a cut.

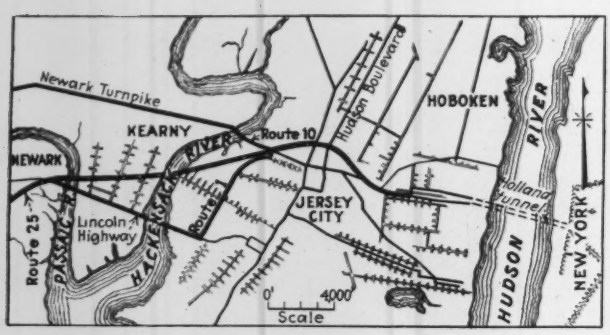
Accordingly, plan 3, involving the high-level crossings, was approved by the State Highway Commission on Oct. 8, 1929, and on Oct. 22 by the New Jersey State Board of Commerce and Navigation. Preliminary plans were then submitted to the U. S. War Department, which had already approved the 35-ft. bridges, with the result than on Dec. 11, 1929, permission was given to proceed with the project.

General Plan

Superstructure—Briefly, the total length of construction involved is about 15,000 ft., or nearly 3 miles. Two duplicate fixed-span cantilever bridges with a clearance of 135 ft. will be built over the Passaic and Hackensack rivers, each with a main span of 550 ft. These will be connected by a steel viaduct, with suitable approaches at each end of the project. There will be a lowering of the roadway level between the two bridges, with two intermediate ramp approaches. Roadway width will be 50 ft. between curbs, sufficient for five lanes of travel. The two cantilever bridges will be duplicate structures awarded on a single contract, but will not be constructed simultaneously. Each main span, as already stated, will



TYPICAL SECTIONS OF PROPOSED ELEVATED VIADUCT
Top—One of two duplicate cantilever bridges. Bottom—Viaduct section showing intermediate ramp.



NEW JERSEY CONNECTIONS WITH THE HOLLAND TUNNEL

Existing roads shown by full lines; proposed routes by heavy broken line indicated as Route 25.

be 550 ft., with suspended spans of 350 ft. Cantilever bridges are favored to avoid the necessity of erecting falsework in the rivers. The viaduct will consist, for the most part, of 300-ft. spans, except where variation is necessary on account of local conditions. Alternate spans of the viaduct will be of the fixed and cantilever types.

Foundations—Throughout the length of the project the soil structure consists of layers of muck over clay, sand and mixed sand and gravel, with bedrock at depths varying from 25 ft. at the Hackensack River to a maximum of 130 ft. at one point in the Kearny Peninsula, between the two rivers, decreasing to 70 ft. at the Passaic River. Present plans call for the use of concrete piles for the shallower foundations, with pneumatic caissons for depths varying from 90 to 130 ft.

Erection Schedule—The project will be divided into a number of contracts comprising three sections, of which the first, from the intermediate ramp in Kearny to that in Jersey City, will be completed and put into operation as soon as possible in order to provide a third independent crossing over the Hackensack River. The second section will complete the Jersey City end; the third, the Newark end, including the Passaic River cantilever bridge. Exploratory borings have been completed along the entire length of the project and contracts for foundation construction on the first two sections have been awarded. Details of these will be found in the unit price section of this issue.

Detailed plans for the steelwork are now being prepared; it is expected that bids for the first steel contracts will be called for about July 1, 1930. The project is being built by the New Jersey State Highway Department, of which J. L. Bauer is chief engineer. H. W. Hudson, assistant construction engineer, is in direct charge of the work.

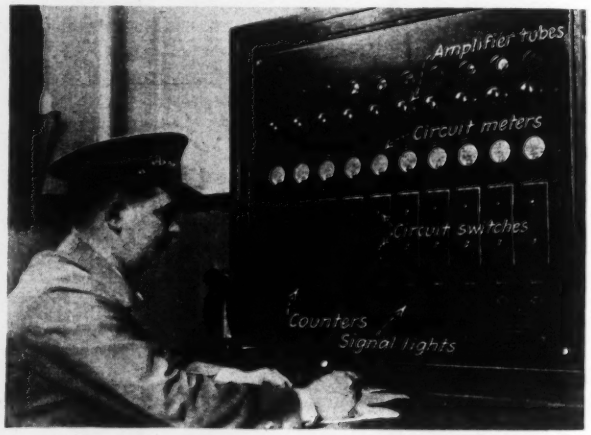
Old Bridge in Germany Accidentally Destroyed

One span of an old bridge across the Main River at Klingenburg, Germany, was accidentally destroyed recently during the construction of river-regulating works. A piledriver was being erected on pontoons in the river below the bridge and a steel cable had been made fast to the bridge railing to be used in raising the leads of the driver into position. During the hoisting the entire span gave way and fell on the pontoons, killing one man and slightly injuring five more. The entire bridge of five spans will be replaced by a new structure, as it had been considered inadequate for some time.

Bridge Traffic Controlled by Photo-Electric Cells

Ambassador Bridge Has Automatic Detectors and Counters on Each of Ten Entering Traffic Lanes

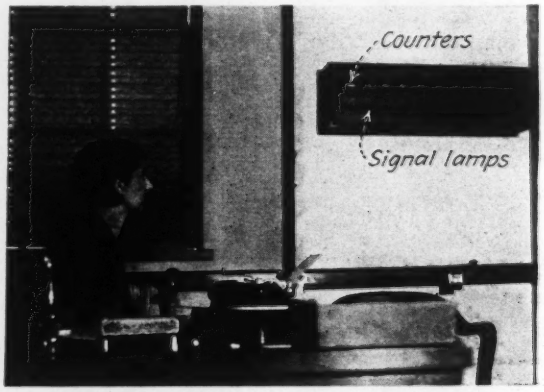
PHOTO-ELECTRIC detectors in the toll lanes at the entrance plazas of the Ambassador bridge, connecting Detroit and Windsor, give rapid and complete check on toll collection with twenty fewer attendants than would otherwise be necessary, according to an article in the June issue of *Electronics*. Benjamin Cooper, of New York, who designed and installed the equipment, reports the installation to be fully successful in speeding up traffic



CONTROL AND REGISTER BOARD IN TOLL HOUSE

handling, giving a complete supervisory control of the movement of traffic and reducing the labor of toll collection.

The wide approach plaza at either end of the bridge contains about fifteen traffic lanes, ten of which, arranged in pairs between the toll houses, are entrance lanes. It is in these lanes that tolls are collected. An automobile entering upon the bridge must come to a stop in the passage between toll houses. In this position it intercepts a vertical beam of light passing from an electric lamp in the ceiling of the passage to a photo-electric cell set in a protected cage in the floor. When it thus shuts off light from the photo-electric cell, the change of current through the latter actuates a relay, which in turn operates a counter register and extinguishes an indicator lamp on the



COUNTER IN SUPERINTENDENT'S OFFICE

register board. This register board is in the chief toll keeper's booth, so that by looking at his board the official can see at a glance which lanes are occupied by vehicles in process of paying toll, and can also read the register count for each lane. A duplicate of the register board is in the bridge superintendent's office, who thus has a direct check on the operation of traffic.

Because of the combination of indicator lamps and register, it is easy for the supervising officials to note from the frequency with which the indicator lights go on and off how rapidly traffic is being cleared or whether abnormal delay is occurring at one point. This counting check makes ticket issuance and collection unnecessary; the vehicles are passed directly upon payment of the toll. The saving in number of attendants results from elimination of ticket collectors.

CAR AT TOLL BOOTH REGISTERED BY VERTICAL LIGHT BEAM

In the ceiling over each of the two lanes between the two toll booths is an electric lamp which throws a beam down upon a photo-electric cell set in the pavement. When a car interrupts the light beam, the change of current flow through the cell actuates through an amplifier tube a relay which moves a counting register in the attendant's booth and a similar register in the superintendent's office.

The relays actuated by the feeble current from the photo-electric cells are designed with enough lag so that a man walking over the cell and intercepting the light beam, or such passing obstructions as bumpers, luggage carriers, or spare tires on cars, will not cause the relay to operate. In order to prevent stray light from general daylight illumination neutralizing the effective light change upon the cell when an automobile (particularly a high-body truck) stands over the cell, the sides of the housing containing the cell are shouldered to cut off stray illumination as far as possible.

Research Field of New Association Outlined

SPEAKING before the initial meeting of the Heavy Clay Products Institute, recently held in Washington, D. C., C. L. Warwick, secretary-treasurer of the American Society for Testing Materials, outlined several ways in which the new Institute can act to aid and supplement the present work of the older society. Objectives of the American Society for Testing Materials, according to Mr. Warwick, are the promotion of knowledge of engineering materials and the development of standard specifications and methods of test. Thus the primary interest of this society is in materials, rather than in the field of design and construction. Mr. Warwick stated that the Heavy Clay Products Institute can render valuable service to the engineering profession, and also aid his own society, by accepting memberships on A.S.T.M. committees, by advocating the widespread use of A.S.T.M. standards in design and construction, and by the development of standards and recommended practice in the field of design and construction.

Among other papers presented at the meeting were several giving research discussions not hitherto made public. Speaking on the acoustical properties of heavy clay masonry, V. L. Chrisler, of the U. S. Bureau of Standards, stated that the greater the weight per cubic foot of material the less would be the sound transmission. He asserted, however, that design rather than material is the controlling factor. For soundproofing against impact noises, for example, he said that such features as a floating floor, a suspended ceiling, or both, are an effective aid to the proper utilization of brick and tile. Heatproofing has somewhat dissimilar requirements in that transmission decreases rather than increases with the density, being dependent on void spaces, according to M. S. Van Dusen, also of the bureau. For heat insulation, partly filled joints are preferable to completely filled or slushed masonry joints, Mr. Van Dusen declared.

J. W. McBurney, research associate of the Common Brick Manufacturers Association at the U. S. Bureau of Standards, outlined the extent of present knowledge on the strength of brick walls. While considerable work has been done in this field, most of this has been confined to testing in compression with concentric loading, and further experimentation is necessary to secure data on tensile strength, transverse strength, shearing strength and compression strength with eccentric loading. Tensile strength, according to Mr. McBurney, would be of little importance were it not for the fact that it determines the second kind of strength, transverse strength. It is believed that the factors which affect tensile strength include the strength of the mortar itself, the nature of the bearing surface of the brick, possibly the water-absorbing properties of the brick and certain other factors grouped under the head of curing conditions. Data on shearing strength are almost totally absent. This question is important from the standpoint of what addition in strength a masonry panel provides for steel construction in resisting lateral forces. Knowledge in respect to compressive strength is somewhat more satisfactory, the speaker stating that it is now possible to predetermine the compressive strength of brick masonry as sharply and accurately as for concrete. The effect of eccentric loading on compressive strength was dismissed with the statement that the few tests available show results in fair accord with those already calculated.

Engineering Conditions in Hawaii

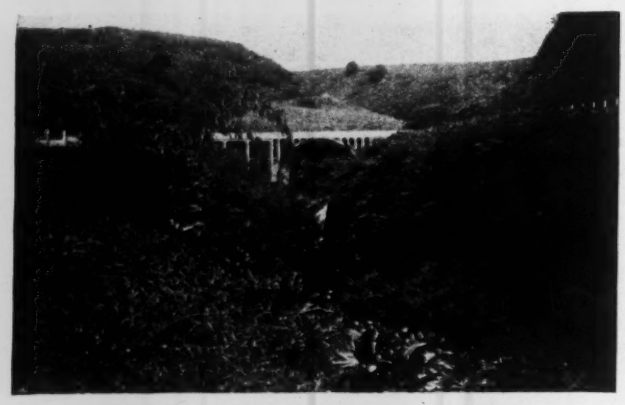
As Seen by a Visitor From the States

Plenty of Work for Engineers and Skilled Artisans, but Native Supply Is Equal to Demand—Survey of the Road System, the Sewage-Works and the Water Supply

By H. E. Babbitt
Professor of Sanitary Engineering, University of Illinois

LIVING and working conditions in the Hawaiian Islands are ideal in many respects and are equal to the standards of continental United States. The atmosphere is American throughout, intensified in its patriotism because of its remoteness from the mainland and because of the large proportion of population of Asiatic and Polynesian races. Characteristic American hustle is tempered slightly by the warmth of the perpetual summer and the moisture of the prevailing humidity. There is plenty of work for engineers, skilled artisans and laborers, and there are plenty of each of these classes to do the work. The University of Hawaii graduates annually enough trained young men to supply the demand for recent college graduates and the population of the islands is sufficient to care for other normal demands. It would be unwise for anyone with meager funds to go to Hawaii depending upon securing work upon arrival. Employment should be obtained before leaving the mainland.

Topography—The principal islands of the Hawaiian archipelago cover an area of about 6,000 square miles. Honolulu, the capital and principal city, is located on the southern side of the Island of Oahu, in the center of the group of islands. The city and county of Honolulu have a population of about 170,000. The next largest city, Hilo, with a population of about 13,000, is on the Island of Hawaii.



HIGHWAY BRIDGE NEAR HILO, HAWAII

Climate—The climate is that of perpetual summer. United States Weather Bureau records in Honolulu show a maximum temperature of about 85 deg. and a minimum of about 62 deg. The humidity is generally high, averaging around 70. A cooler climate exists at high altitudes and the peaks of Mauna Loa and Mauna Kea, on the Island of Hawaii, are snow capped for part of the year. The moderate temperature existing at sea level at this location in the tropics results partly from the cooling effect of the trade winds which blow almost constantly from the northeast. The annual rainfall varies between more than 400 to 600 in. at the rain gage on Mount Waialeale, on the Island of Kauai, to about 15 in. at other points. The rainfall on the windward or northeasterly side of the islands greatly exceeds that on the leeward side. Hilo, the principal port on the windward side of Hawaii, has an annual rainfall of 150 in. Honolulu, on the leeward side of Oahu, has only 15 in. of rain annually. The rainfall on Mount Waialeale is probably the greatest in the world at a point where a rain gage is maintained. At low elevations the rainfall is precipitated in typical tropical downpours lasting but a few minutes, frequently while the sun continues to shine. Fogs and hurricanes are unknown; there is little thunder and lightning, and but few storms. Construction work is seldom interrupted by the weather.

REPAVING AFTER THE CONSTRUCTION OF A SEWER, HONOLULU

The people, their ideals and living conditions are Americanized. The races of mankind represented on the islands are extremely diverse, as is indicated by the figures of population shown in Table I. The preponderance of Japanese and citizens with Japanese antecedents is to be noted. The Filipinos represent also an important group. It is upon these two groups that dependence is mainly placed for labor, particularly plantation and unskilled construction labor.

TABLE I—POPULATION OF HAWAIIAN ISLANDS BY RACIAL ANTECEDENTS, 1928

Antecedents	American Citizens	Aliens	Antecedents	American Citizens	Aliens
Hawaiian	20,720	.....	Other Caucasian	37,082	420
Caucasian-Hawaiian	15,948	.....	Chinese	15,058	10,252
Asiatic-Hawaiian	10,036	.....	Japanese	83,252	51,348
Portuguese	26,145	2,972	Korean	3,500	2,818
Rorto Rican	6,781	.....	Filipino	8,208	51,870
Spanish	1,170	639	Others	376	172

Grand total of population, 348,767.

Transportation Facilities—Transportation from Pacific ports and on and between the principal islands is good. Communication with the mainland is frequent, steamers arriving and departing daily from important

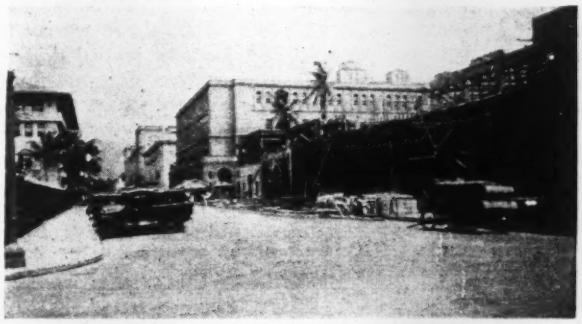
ports of the Pacific. Honolulu is the half-way house for Pacific traffic, hence freight is moved frequently and expeditiously. The inter-island steamers maintain a regular semi-weekly or tri-weekly schedule, supplemented by other sailings. They are [illegible]ld [illegible] fast, commodious, well-appointed boats of about 4,000 [illegible]ns displacement. Railroads for public service are operated on the islands of Oahu, Hawaii, Maui and Kauai, as is shown in Table II.

TABLE II—PUBLIC SERVICE RAILROADS OF HAWAII, 1928

Company	Miles of Track	Freight Carried, Tons	Passengers Carried	Gage
Oahu Ry. & Land Co., Oahu	171.83	1,026,723	619,578	36 in.
Koolau Ry. & Land Co., Oahu	11.0	57,422	381	Narrow
Hawaii Ry. & Land Co., Hawaii	20.0	49,394	86	Narrow
Hawaii Consolidated Ry. Co., Hawaii	100.86	475,378	266,828	4 ft. 8½ in.
Kahului Ry. Co., Maui	42.81	442,751	186,155	Narrow
Kauai Ry. Co., Kauai	7.06	34,062	.....	Narrow
Ahukini Ry. Co., Kauai	15.0	128,561	.....	Narrow
Total	368.56	2,214,291	1,073,028	

Extensive narrow-gage, light railroads are operated on plantations in addition to the railroads operated for public service. The most expensive railroad construction is to be found on the Island of Hawaii. The rough topography of this island has necessitated the making of deep cuts, tunnels and high fills, and the erection of long-span bridges.

Roads—The principal islands are provided with good roads, as is indicated by the statistics in Table III. Most of the concrete pavements are in Honolulu and on the Island of Oahu. In addition to the public highways there are 1,377 miles of improved plantation highways which are open to the public. There is no uniform type of existing highway improvement. Rural roads vary from 16 to 20 ft. in width. Most of the principal business streets in the busy sections of Honolulu are narrow, with width between curbs of 25 to 30 ft. Residential streets are wider, and a portion of King St., opposite



DILLINGHAM TRANSPORTATION BUILDING UNDER CONSTRUCTION IN HONOLULU
Every building shown is of recent construction. Note the smooth pavement, the type of street light.

the territorial government building, is more than 100 ft. wide. The program for future highway construction

TABLE III—MILES OF PUBLIC HIGHWAYS IN HAWAIIAN ISLANDS

Type	Urban	Rural	Total
Concrete	81.3	62.2	143.5
Asphalt-macadam	163.3	498.1	661.4
Gravel	25.0	360.8	385.8
Graded only	34.6	492.5	527.1
Total	304.2	1,413.6	1,717.8

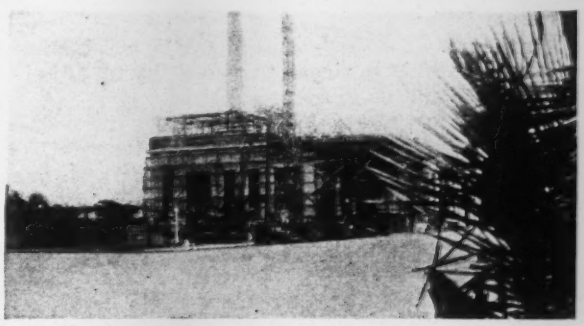
and improvement by the territorial government is ambitious, but until the next meeting of the legislature in 1931, the only territorial highway construction for which appropriations have been made will be completed on the Island of Maui. The highway to be built will consist

REINFORCED-CONCRETE WHARVES AND ALOHA TOWER HONOLULU

of 17 miles of concrete pavement from the seaport to the National Park boundary, and it is expected that the National Park Service will complete the remaining 9 miles to the summit of Haleakala, at an elevation of about 10,000 ft. above sea level.

Municipal and county pavements are constructed and maintained under the direction of the city or the county engineer. Improvements of these highways is constantly in progress. Expenditures for public works constructed or maintained under the direction of the county engineer of Hawaii, who is also the city engineer of Hilo, amount to more than $1,000,000 annually. The largest item of this expediture is for roads and highway bridges.

Industries—The principal industries on the islands are the growing and manufacture of sugar and the raising and packing of pineaples. For the year ended Dec. 31, 1927, approximately $70,000,000 worth of sugar and $35,000,000 worth of pineapples were exported. The next most important product is coffee, which showed a poor third for the same period at about $1,780,000. The total exports in 1927 amounted to about $127,000,000, as compared with total imports of about $80,000,000. No single import stands out above all others. The greatest imports are fuel oil and automobiles. The principal building materials imported include cement, lumber, and steel. None of these materials is procurable on the islands, although the necessary materials for the manu-



ADDITION TO POWER HOUSE, HAWAII ELECTRIC CO., HONOLULU

facture of cement, excepting fuel, are available. In 1927 there were imported $700,000 worth of cement, approximately $3,500,000 worth of lumber and wood products and $5,500,000 worth of iron and steel. Imports of steam and electric machinery amounted to about $5,000,000.

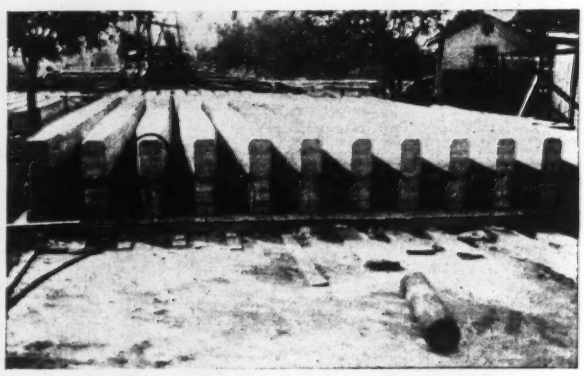
The principal civil engineering projects of major importance and interest to the public are conducted under the direction of the superintendent of public works of the territorial government. These works consist mainly of harbor and municipal improvements and highway construction. The design and construction of water- and sewage-works for Honolulu are also under the territorial government, but the operation of the works is still in the hands of the city officials.

Harbors—There are no good natural harbors, except Pearl Harbor, on the islands. The principal harbors have been made by dredging and by the construction of breakwaters. The harbor at Honolulu is almost entirely a dredged harbor protected by a low island, some made land, shoals which may be exposed at low tide, and breakwaters. The harbor work at Nawiliwili, on the Island of Kauai, is the largest piece of harbor work now in progress. Other harbor and waterfront work now in progress includes the completion of the breakwater at Hilo, refilling and the making of land along the waterfront at Honolulu, the Kalakaua Ave. bridge in Honolulu, and extensive work by the United States government at Pearl Harbor. The reclamation of the beach at Waikiki will probably be undertaken when sufficient funds are available and satisfactory agreements can be reached with riparian property owners. At present sand is being carried away from the beach in such a manner as to endanger its attractiveness. This has probably been caused, in part, by the encroachment buildings and sea walls, which may have changed the direction of shore currents. Extensions and improvements to the John

HARBOR CONSTRUCTION, HONOLULU

Rodgers Airport will amount to $200,000, and improvements will be made to airports at Ford Island, at Schofield Barracks and on other principal islands.

Harbor construction is made difficult by the unevenness of the coral rock in elevation and in strength. Of two piles driven within a short distance of each other one may strike rock 20 to 30 ft. lower than the other. Occasionally after a pile has struck rock a few more blows will cause it to break through and drop of its own weight for many feet. Wooden piles are useless for permanent underwater structures. The teredo will cut through a wooden pile in less than twelve months. Concrete is used almost exclusively, therefore, and concrete piles 50 to 75 ft. in length are not unusual. Where longer piles are needed, it is the custom to splice a wooden and a concrete pile together. Teredos will not attack wood below the mud line. The wooden pile is, therefore, driven first until its top is near the water surface. The concrete section is then spliced on by means of a heavy concrete coupling, and the two piles are driven until the concrete coupling is well below the mud line. Piles of this type are in use for lengths over 100 ft. The action of sea water on concrete has not been found detrimental. It is believed that the power of concrete to resist corrosion is due to the quality of the lava



CONCRETE PILES FOR KALAKAUA AVE. BRIDGE, HONOLULU

rock aggregate, the use of a dense mixture and the use of a good quality of portland cement.

Water Supply—The water suppliy of Honolulu is obtained from artesian wells located within the city limits. The cap rock confining the artesian water is at a depth of about 600 ft. under the city. In 1888, when records were first made, the artesian water rose 42 ft. above sea level. At present it will rise about 28 ft. above sea level. In 1926 a pressure of only 23½ ft. was recorded, the lowest pressure yet reached. The artesian pressure fluctuates with the rainfall, but it is evident from the decreasing characteristics of the artesian pressure that the draft on the area is greater than the supply. It will probably be necessary to diminish the draft on the present source of water and to obtain water from other sources. This change will be necessitated in the immediate future, as further reduction of the artesian pressure will admit salt water to the wells because of the greater specific gravity of the salt water. It has been computed that the minimum safe artesian pressure is about 22 ft. above sea level. An adequate supplementary surface supply is available on Oahu, but it will require filtration. Complete plans and estimates of cost of the works for the additional supply have been made. Construction awaits only the necessary appropriations by the legislature. Abundant artesian and surface supplies exist on the other principal islands, but the artesian supply in the vicinity of Honolulu is the only public supply that is approaching exhaustion. Private wells for industrial plants, irrigation purposes, hotels, etc., are increasing in number and are an increasing drain upon artesian sources. An attempt by the territorial water commission to control this source of supply for the public welfare has been frustrated by the courts. It remains for the legislature to come to its defense.

Sewerage—Main and intercepting sewers and sewage-works for Honolulu are designed and constructed under the direction of the territorial commissioner of public

works. The city pays for the work, designs and installs all small sewers and maintains and operates all sewage-works. Sewerage facilties are available in the greater portion of the city. Unsewered sections exist in low-lying territory and in recent additions to the city. Unsewered districts are provided with cesspools. The leaching action is sometimes slow, due to the impervious of the soil, necessitating frequent pumping of the cesspools. The pumping of cesspools is done by the city without charge to the householder. In order to diminish the expense of pumping and to provide sewers for the entire city a comprehensive system of intercepting and supplementary sewers is under construction. The largest piece of sewer construction under way comprises about 19,000 ft. of sewer 4 ft. wide by 5 ft. high, all except a short section being constructed in tunnel. The principal material penetrated is a soft volcanic rock which is devoid of moisture, contains no gases and requires little timbering. The cover over the tunnel varies between 8 ft. and 60 ft. The bottom of the main interceptor is almost flat and along the greater part of its length it is provided with a cunette to care for the low flows which are expected at the start.

The sewerage system is being constructed in accordance with a modification of a plan made by Rudolph Hering in 1897. Hering's original plan has been greatly outgrown, but the principle which he established, that no sewage shall pollute the harbor or beaches, is adhered to. The main outfall sewer consists of about 2,000 ft. of submerged 48-in. cast-iron pipe which terminates outside of the reef at a depth of about 60 ft. This outfall was constructed in 1926.

Some trouble has been experienced with the deterioration of concrete in sewers, due apparently to the action of hydrogen sulphide. It has been found in industrial districts that the action of pineapple juice is also extremely detrimental to concrete. The concrete intercepting sewer is, therefore, being lined entirely on the interior surface with vitrified clay tile to prevent the destruction of the concrete by gases, pineapple juice or other corrosive substances in the sewage. The cement joints in the clay tile are coated with a bituminous paint for the same reason. A section of the intercepting sewer through soft ground at a small depth is being constructed of 36-in. vitrified clay tile. It is surrounded with 6 to 9 in. of reinforced concrete designed to act as a 15-ft. end-supported beam. The joints are filled with a poured asphaltic compound to prevent sewage from coming into contact with the concrete.

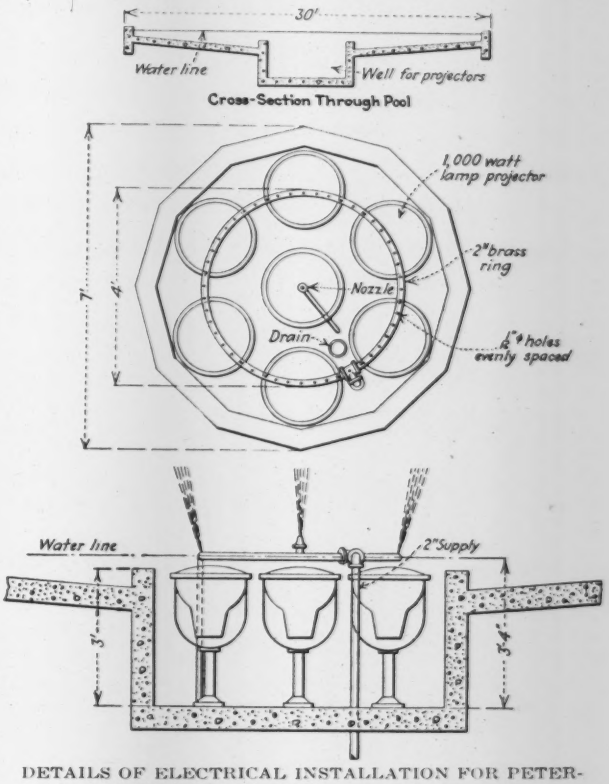
Construction—Building construction on the islands has been active for some time. It is marked by the completion of many beautiful and costly business buildings, principally in Honolulu. The building permits issued in Honolulu in 1927 amounted to $6,397,563 and in 1928 to $6,745,750. At present there is much building activity. The three major buildings under construction include the Advertiser Building, the Dillingham Transportation Building and the extension to the Hawaii Electric Co.'s power station. A new city hall has just been completed. Each of the projects now under construction is estimated to cost in the neighborhood of $300,000. The major buildings projected in Honolulu and vicinity for the immediate future include the C. Brewer Building, the Brewer Estate Building and the E. O. Hall Building. It is expected that each of these will cost about $300,000. The new plant of the Kamehameha School will cost about $1,000,000.

All of the recent large buildings and many of the dwellings on the islands use concrete to a great extent in their construction. The action of termites on lumber is a serious objection to its use. The interior of the Royal Palace, which houses the governor's office and some of the administrative bureaus, is now undergoing comprehensive renovation and rebuilding, partly on account of the action of termites and dry rot on the interior timbers. The exterior of the building is of masonry construction. Practically all building materials are imported from the mainland.

Engineering works for the sugar and pineapple plantations give employment to many. These works include highways, railroads, irrigation and drainage works, cane sluices, bridges and other important structures. The extensive cane sluices are a feature of the landscape on portions of the islands and the plantation roads are an important part of the road systems of the territory.

Illuminated Fountain at Canadian Filter Plant

AN ILLUMINATED fountain has recently been installed at the water-filtration plant park of Peterborough, Ont. The lighting projectors and water jets for the fountain are located in a center well of a shallow



DETAILS OF ELECTRICAL INSTALLATION FOR PETERBOROUGH'S ILLUMINATED FOUNTAIN

pool, 30 ft. in diameter. Seven projectors of the submerged type are provided, each containing a 1,000-watt lamp. The projectors are arranged so that six form a circle around the seventh light in the center. The center light is fitted with a clear lens, but of the six others there are two each of red, green and amber. A central jet of water attains the height of 35 ft., and an outer 4-ft. ring of fine spray, a height of 10 ft. A detailed illustrated description of the fountain is given in *Contract Record and Engineering Review*, Toronto, Ont., Oct. 16, 1929, p. 1233.

Water Purification Dominant Topic

Many Papers Before American Water Works Association at St. Louis on Making Water Better for Use—Wells, Pumps, Pipe, Finance, Airport Supplies Among Other Subjects

Engineering News-Record Staff Report

AT THE FIFTIETH ANNUAL CONVENTION of the American Water Works Association, held at St. Louis last week, the dominant topic was water treatment. Many of the papers were highly specialized and most of them were read before the water purification division. Others, of wider interest, were presented at the general sessions. The same kind of distribution was made of papers on finance and accounting. The plant operation and maintenance division had a "round-table" discussion, besides which operation topics were discussed at the general session.

A commendable feature of this year's program was a shortening in number of topics, compared with earlier years, and a concentration of related topics. If this was intended to provide more time for general discussion it failed signally, but the failure was caused by scheduling from one to four or five members to discuss each paper. In fact, the formal entrants did not always have time to present their papers—for such practically all of the set discussions were. The program would have been still more crowded had all those scheduled been present. A number of absentees, who had not arranged for substitute readers, had their papers read by title only, while one or two of those present, because of sympathy for the audience and perhaps a bit of pique, handed their papers in without reading. The net result of all this was that except for a few "round-table" subjects Monday afternoon practically no contribution to the knowledge of the scheduled topics was made by any one not formally entered on the program, while many who were entered had their time cut. Most of the material presented was of high order, but the proceedings lacked the interest of the give and take of impromptu discussion.

Presidential Address: 50 Years in Retrospect

IN PLACE of a formal address at the opening of the convention the retiring president, Prof. Jack J. Hinman, Jr., reviewed the progress of the association since its formation at St. Louis, in March, 1881, with 22 superintendents and engineers present. One of the topics discussed at that meeting was the relative values of fuels for pumping—coal, wood, oil, gas and corncobs, the latter valued at $1.60 per ton. Other subjects were materials for mains and services, rates, water waste, frozen fire hydrants, the Ellis tables, pressures, sleeves and the work of plumbers.

In 1913 geographical and technical sections were authorized, the Illinois section and the chemical and bacterial (now water purification) division being the first in each class. In 1921 the council on standardization was created, as a result of which "The Manual of Water Works Practice," a large handbook, was published in 1925 by the association. In the course of his talk Professor Hinman threw on the screen portraits of the first twenty presidents of the association.

Committee reports were again notable by their absence, owing in part to the presentation of new information almost wholly by individual contributions and perhaps more largely to the current reorganization of committee work under the relatively new committee on water-works practice, which has taken the place of the standardization council that got up "The Manual of Water Works Practice," already mentioned. Reporting briefly for the new committee, the chairman, Malcolm Pirnie, New York, said that there will be twelve main and many subcommittees covering as a mosaic the whole water-works field. A number of these committees are well started. Instead of early revision of the manual new material will appear in the *Journal* from time to time. Later, one or more supplementary volumes will be published.

Finance and Accounting

The technical division on finance and accounting, organized a year ago, held a session or two of its own. In addition, a paper on the importance of this field, by H. Gordon Calder, assistant comptroller, Federal Water Service Co., New York City, was read at one of the general sessions. At a division meeting Hal F. Smith suggested a plan of operation that included committees on finance, accounting, taxation, office management, purchases and supplies, personnel, public relations and legislation, it being understood that the "outlet for pronouncements of the division would be the committee on water-works practice." C. Van den Berg, president, Alabama Water Service Co., Birmingham, Ala., and F. W. Schulz, comptroller, Community Water Service Co., New York City, cited financial gropings and losses due to deficient accounting by privately owned plants. A scheme of accounting, apparently designed with the needs of publicly owned plants in mind, was outlined by A. P. Michaels, general manager, Orlando (Fla.) Utilities Commission. Plans for new projects and extensions should be well in hand so advantage can be taken of favorable labor conditions and materials markets. In general, extensions to mains should yield a self-supporting revenue within a year.

Various Topics Old and New

Airport Water Supply—A new subject for the association, and one of rapidly increasing magnitude, airport water supply, was presented by S. F. Newkirk, Elizabeth, N. J. The problem is often made costly, even if not otherwise difficult, by the location of airports far from public water-supply systems. This may necessitate an independent supply, perhaps from wells. The fire demand may be too great for complete elevated storage, but sufficient of the latter for 30 minutes of fire service is needed, while the elevated and ground storage combined should serve for two hours. The kind of fire-fighting facilities to be provided needs study. There are differences of opinion as to the advisability of using sprinklers, but fire-protection engineers favor them. Clarence Goldsmith, assistant chief engineer, National Board of Underwriters, Chicago, thought sprinklers desirable where a sufficient water supply is available. He referred to a forthcoming import of a fact-finding commission on airport water supplies, the contents of which have not been made public.

Water Demand in Arid Regions—The heavy water requirements for arid and semi-arid regions was the subject of a paper by N. T. Veatch, Jr., Kansas City, Mo. The table included demand figures gathered from a large number of cities; also a small table comprising demands in several cities of different climatological conditions. Some of these figures, in gallons per tap, were, in terms of average daily demand: Evansville, Ind., 403; Tucson, Ariz., 916; Phoenix, Ariz., 884; Wichita Falls, Tex., 327. The corresponding percentages of the maximum hour to the maximum day were 166, 137, 170, and 188 per cent.

Hydraulics of Deep Wells—The late L. R. Balch, for some time with Mead & Seastone, Madison, Wis., devoted much time to the law of flow of wells, interference of one well with another and allied problems. Based on a study of existing wells, he simplified the well-known Slichter formula for the flow of underground waters. A paper covering the ground indicated appeared in the association *Journal* for June, 1930. To bring the paper more generally and more understandingly before the association it was outlined in simple terms at the convention by Prof. D. W. Mead, who remarked that perhaps the data could be used in studies for or of large well supplies, although Mr. Balch felt that his conclusions had not yet been applied in enough places to give certainty as to their usefulness. Professor Mead, W. G. Kirchoffer, also of Madison, and Lafayette Higgins, Des Moines, Iowa, all urged the need for more data on the design of wells. Mr. Kirchoffer expressed some doubt as to the Slichter formula and related the plotting of personal observations on wells which led him to deduce a formula of the vortex type, indicating, he thinks, a water flow wellward in curved instead of straight lines.

Pumps and Pumping

Pumping plants were given four places on the program, with a total of a dozen authors, including those formally assigned to discussion, a number of whom did not appear.

Diesel Engines—On diesel engines, R. D. Hall, of the Worthington Pump & Machinery Corp., New York City, said there is no question that these engines are in waterworks service to stay and that they are best suited to installations of moderate size. Their chief rival is the steam turbine as a primer mover. F. G. Gordon, Chicago, said diesel engines may be used as primary installations or be added to increase the efficiency of existing plants. A. D. Couch, New York, said oil for such engines must not form carbon. It is hard to get reliable data for the purchase of fuel oil, as its source is so likely to change. Lubricating oil for diesel engines should be fluid and, like fuel oil, should not form carbon. Too much lubrication is as bad as too little.

Deep Well Pumps—The relative advantages of air lift and centrifugal pumps for deep wells was considered by several members, led by C. N. Ward, of Mead & Seastone. The air lift is limited, once water is brought to the surface, to operation against low additional lifts. A. P. Pigman, New York, contrasting the two types, said the air lift has a low first cost, is reliable and operates at low cost and shows a good efficiency at moderate pumping rates, while the turbine has high first cost and high efficiency. In some cases the two may be combined advantageously. Thomas H. Allen, Memphis, Tenn., remarked that the present trend is toward the turbine pump. It can deliver water to any height but has to be removed from the well for overhauling. The simplicity of installing air lifts makes for inefficient installation.

Other Pump Topics—On wastefulness in the operation of pumping stations, T. R. Hughes, American Water Works & Electric Co., New York City, said that low service pumping plants are places to guard against inefficient operation. The "romance" of planning and building a large pumping station was the keynote of a paper on the relatively new pumping station at Chicago, by L. D. Gayton, city engineer. The station contains four 75-m.g.d. steam-turbine driven pumps and cost some $4,500,000.

Pipe and Distribution Systems

Joints—Extensive use of steel pipe with bell-and-spigot joints also of steel and with cement as the jointing material (2 to 1 mixture), at Pasadena, Calif., was described in a paper sent by William W. Hulbert, of that city. The practice began in 1905. By 1906 a large mileage was in use. Today Pasadena has 55 miles of trunk and more than 300 miles of distribution mains of this type. Economy in first cost and in maintenance, higher carrying capacity, less electrolysis and greater flexibility are advantages of these joints. W. W. Brush said he would not be surprised to see cement joints used in New York City in the near future.

Experience with patches on steel pipe where coupons had been taken out for testing the strength of welded longitudinal joints were reported by W. W. Brush, New York, and G. Gale Dixon, Youngstown, Ohio. Mr. Brush's account of the failure of two patches is given in abstract separately. Mr. Dixon stated that a considerable mileage of 36- and 42-in. steel water pipe is being laid for the Mahoning Sanitary District (Youngstown, Ohio, and vicinity), the longitudinal joints being welded and the girth joints riveted. The contractor suggested doming the patches where coupons were removed, to take up the strains.

The Oldest Cast-Iron Pipe—Cast-iron pipe laid in the period from 1664 to 1685 to supply fountains in the gardens of Versailles, France, was described, with lantern slides, by Burt B. Hodgman, using material gathered by him on a recent visit. The main line of pipe has a diameter of 20 in.; all the pipe has flanged and bolted joints, with leather gaskets. It is laid in a tunnel, which was entered by the speaker. Apparently the outside of the pipe was never painted or otherwise protected. The bolts, which were of steel, have been renewed. The pipe was found to be in good condition after a use of some 250 years. It is kept under a pressure of about 20 lb., although the fountains are played only once in some two weeks. Well water is now used.

Sand-Spun Cast-Iron Pipe—Bad luck as regards attendance was in store for the last number on the program, only a few being present when it was reached about 4 o'clock Friday. Nothing daunted and with aid of lantern slides, the production of cast-iron pipe, both ordinary sand-cast and sand-spun, was described by Warren A. Brown, engineer of R. D. Wood & Co., Philadelphia. Sand-spun up to 48-in. diameter is or soon will be on the market, as also the same kind of pipe in 20- instead of the customary 16-ft. lengths—contrasted with 12 ft. for ordinary cast-iron pipe.

Pipe Exposed to Frost—Protection of water mains exposed to freezing, said R. L. Dobbin, Peterborough, Ont., was not discussed in the published porceedings of the association between 1908 and 1928. In the latter year there was a paper on the subject before the Ca-

nadian section. Without water circulation no amount of protection of exposed mains will prevent freezing, but a small movement of water will suffice. In a Hudson Bay town, Canada, where frost is said to have been found until rock was reached at 117-ft. depth, it is proposed to put the water mains above ground, cover them with moss and roof the moss with steel to keep out the wet.

Service Connections—In the course of a discussion on materials for service pipe, J. E. Gibson, Charleston, S. C., told how corrosive soil conditions there had led to the use of lead. This material was continued after making tests of copper, brass, and cement-lined iron or steel pipe. Experience of New Bedford, Mass., said S. E. Taylor, had also resulted in lead as a standard, but that merely illustrates that the choice depends largely upon local conditions. There seems to be no advantage in changing to copper in New Bedford.

Planning Distribution Systems—Development of water-distribution systems at Detroit and St. Louis was outlined by F. H. Stephenson, Detroit, and Thomas J. Skinker and Meyer Serkes, St. Louis, the papers giving attention to feeders and other important elements. The first paper, which was read by title only, is separately abstracted. The second paper described the division of St. Louis into seven sections and many sub-sections for study. Needs by five-year periods to 1955 were estimated. Favorable topography and reservoir sites make necessary only two main distribution areas at St. Louis, whereas at Detroit more are required because of the general flatness of the city, which has made desirable a number of large elevated tanks.

Plant Operation and Maintenance

A dozen topics were assigned for a round-table discussion Monday afternoon under the auspices of the division of plant operation and maintenance, each with a set speaker to introduce the subject. The program was too long to be completed. Discussions of some pipe problems are given elsewhere in this report, with other discussions on pipe. Notes on hydrants, valves and painting standpipe and tanks are here given: To prevent risks of damage to fire hydrants, C. W. Winkle reported that the Indianapolis Water Co. has provided a considerable number of hydrants with $1\frac{7}{8}$-in. connections so contractors and others need not use the $2\frac{1}{2}$-in. hose connections. When fire hydrants are placed at street intersections they should not be within 25 ft. of either corner, to avoid their use as buffers to automobiles.

Breaks in valve bonnets at Charleston, S. C., due to the expansion of concrete sub-base pavements were reported by James E. Gibson.

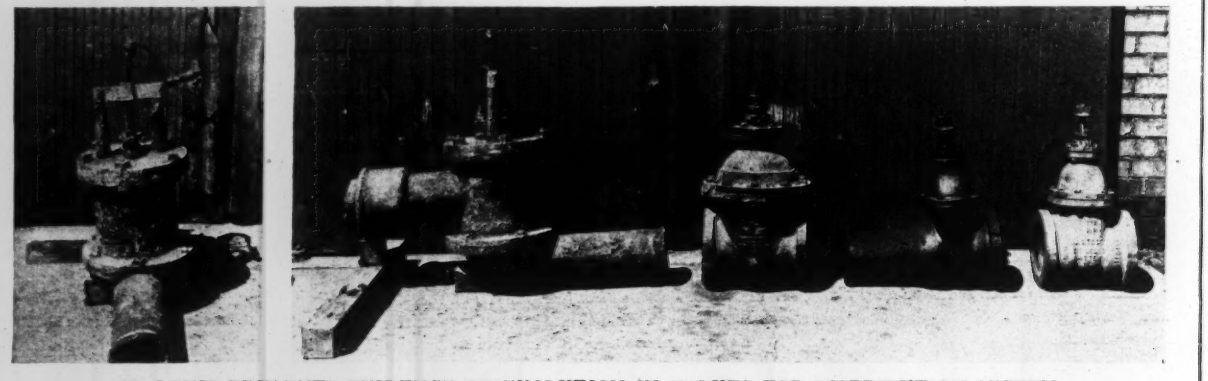
For painting the exterior of standpipes and elevated tanks J. E. Gibson, Charleston, S. C., reported the use of red lead and linseed oil followed by a protective coating. For interiors, A. O. Doane, Boston, reported that red lead and linseed oil is good for ten years. For use as a lining to steel filter tanks, cement, $\frac{1}{8}$ to $\frac{1}{4}$ in. thick, with a protective coating to prevent checking, was reported by E. O. Sweet, Birmingham, Ala.

At one of the general sessions, a device for automatic telephonic indication of water levels in use at Washington, D. C., was described by Dewey M. Radcliff, U. S. Engineer Office. The device is attached to ordinary telephones.

Water Purification and Conditioning

Most of the many papers on water treatment for potability and industrial service were presented to the water purification division, but a few of a more general character, and also some on railway water service, were read at the general sessions. There was also the usual conference of the committee on boiler feed water studies, for which five topics were scheduled, including a progress review by S. T. Powell, chairman; British aspects of the problem, by Dr. A. M. Chapman, Sheffield, England; embrittlement of boiler steel, by Dr. Splittberger, and advantages of treatment for evaporators, by Prof. Hugo A. Haupt, both of the two last named of Bautzen, Germany. Allied to water treatment was a review of outbreaks of water-borne diseases during the past ten years and a warning, with detailed examples, of the dangers of infection through private cross-connections within buildings.

Progress in the Art—The past 25 or 30 years has brought no changes in the basic process of water purification, which are the same as they were a hundred years ago. Thus did Abel Wolman, speaking for himself, Wellington Donaldson and Linn H. Enslow, open a summary of a joint paper by the three on "Recent Progress in the Art of Water Treatment." The most significant change in 25 years has been in the public demand, which, progressively, has been for cleanliness [to the eye], safety and then for a variety of other qualities. The art keeps pace with the demand. There has been a continuing struggle, now largely successful, with tastes and odors. Need for softening is not yet



ST. LOUIS PRESENTS EVIDENCE OF EVOLUTION IN VALVES FOR DISTRIBUTION SYSTEM

The veteran shown twice, on the left, was put into service in 1830 and removed in June, 1873. The next valve is about 25 years old, and the two on the right are recent. A valve similar to the old one shown on the left was removed in 1929. Presumably it also was a part of the original water-works system, built in 1830, thus indicating a service of almost 90 years.

fully recognized by the public. W. W. Brush took issue with the assertion that the consumer creates the demand for higher quality. Lack of progress in one direction was noted by Mr. Brush; so far no way has been shown to prevent the corrosive action of Catskill aqueduct water.

Turbid Waters—Another general session paper took up the treatment of highly turbid water, with particular attention to experiences at St. Louis, where presedimentation is brought into play before the application of coagulents, and great pains are taken in mixing the chemicals with the water before it goes to the coagulation and sludge-removal basins prior to filtration. The author of this paper, John D. Fleming, stated that without continuous sludge removal, under conditions which he stated, the coagulation basins would fill with sludge in 53 days. A part of the sludge removed is returned to the presedimentation basin, increasing its efficiency by half. The coagulation basins at the new Howard Bend plant, St. Louis, are 450 ft. square. They are equipped with revolving scrapers which push the sludge to the center for removal. Ice in the basins put the sludge sweepers out of commission last winter, due in part to the submerged supporting trusses. Abel Wolman asked Mr. Fleming what plans were on foot to meet the ice conditions hereafter. The reply was none, except to stop continuous sludge removal in the winter, but Mr. Fleming added that in a later form of sludge sweeper the supporting truss is placed above water, so it will not encounter ice. F. C. Dugan, Louisville, Ky., said he did not think it is known at what lowness of turbidity presedimentation would not be economical.

Tastes and Odors—At the three half-day sessions of the purification division seventeen papers were presented. The first session was devoted to the developments in processes designed to eliminate objectionable tastes and odors. A paper presented by Frank E. Hale, New York, described the solution of an unusual problem of taste caused by the contamination of a well supply on Long Island by gasoline leakage from a garage. The gasoline, in combination with chlorine applied to assure sterilization, produced the characteristic medicinal taste of a chlorophenol compound. Superchlorination, followed by dechlorination with sulphur dioxide, was successfully employed to render the supply satisfactory. N. J. Howard, Toronto, summarized the progress made during the past year in the application of sulphur dioxide as a dechlorinating agent at Toronto, Ont. Difficulty has been experienced there in maintaining sufficient pressure in the gas containers to assure a steady flow into the water being treated. The difficulty was overcome by installing evaporators and keeping the room temperature at 100 deg.

Activated Carbon to Combat Tastes, Odors—The use of activated carbon was the subject of three papers. A. S. Behrman and H. B. Crane, Chicago, described the general characteristics of the various types of activated carbons and the various uses to which the material can be put. It has been found that only with filtered water can satisfactory results be obtained in the elimination of tastes and odors. Double filtration, first through sand and then through carbon, is therefore necessary. The plant at Chester, Pa., in which the carbon material has been used in the treatment of a highly polluted water, was described by George D. Norcom, New York. The problem at Chester was more particularly one of the removal of an extremely offensive odor caused by the heavy sewage pollution of the surface supply. The odor prevailed after sand filtration. The use of Darco, one of the types of activated carbon, was successful in eliminating the odors. Revivification of the agent was effected by applying steam to the underdrain system. John R. Baylis, Chicago, presented the results of observations made during the past year at the Chicago experimental plant. No data have been obtained as yet on the length of service to the material before requiring revivification. Beds of Darco in service for seventeen months have not yet been reduced in efficiency to the point where such a process is necessary. In the discussion which followed these presentations George R. Spalding, New Milford, N. J., described his experiences in adding pulverized activated carbon to the water entering the coagulation basin. Results from this treatment were very satisfactory.

Color Removal—An unusual color-removal plant, used satisfactorily as an experimental unit at Los Angeles, was described in a paper written by Dr. Carl Wilson. In studying possible methods for the treatment of a highly colored well water it was found necessary to use sand of 0.9 mm. effective size and to reduce the thickness of the sand bed to 10 in. and the freeboard to a like amount in order to obtain a proper effluent. Ferric chloride, as a solution, was used as a coagulant, and the sludge returned to the mixing basin in order to utilize all of its color-absorbing powers. Dr. George G. Nasmith, Toronto, Ont., outlined the operation of the trial filter plant at Ottawa, Ont., which has demonstrated the feasibility of using the highly colored water of the Ottawa River as a supply for the city.

Prechlorination—H. W. Streeter described the effects on filter plant efficiency of prechlorination as shown by the operation of the U. S. Public Health Service experimental plant at Cincinnati. Although the final plant effluent is improved by prechlorination, the individual efficiencies of both filtration and postchlorination are somewhat impaired. By the use of prechlorination raw water containing as many as 20,000 B. coli per cubic centimeter could be filtered to produce an effluent passing the U. S. Treasury Department standards, while without such preliminary dose, a concentration of 10,000 is the highest that can be used safely.

Manipulation of the pH value of the water at Springfield, Ill., was described by Charles H. Spaulding. The methods used included the application of lime prior to coagulation and recarbonation to produce a chemically stable effluent. The use of anhydrous ammonia in conjunction with chlorine and the experiences with such treatment at Lancaster, Pa., and Cleveland, Ohio, were described in papers by Edward D. Ruth and Joseph W. Ellms respectively. At both cities it was found to be a successful treatment for the elimination of tastes and a sterilizing agent of great efficiency. Chlorination experiences in Chicago were given in a paper by H. H. Gerstein.

Filter Washing—During the past year the Detroit plant has been operating its filters in accordance with the findings of the experimental work done there in 1928. Washing the filters to the highest degree of intensity possible with the existing wash system has prevented the reaccumulation of incrusting substances on the sand grains and has practically eliminated side-wall cracking. The results of the year's experience was described in a paper by W. M. Wallace.

Railway Water Supplies—About a third of the immense volume of water used for railway purposes in the United States is bought from the public water sup-

plies along the railway lines, said C. R. Knowles, superintendent of water service, Illinois Central Railway, in a paper on "The Development of Railway Water Supply Practice." Of the water supplied by the railways themselves an increasing percentage is being treated to fit it for use in locomotive boilers. Every railway line has to use water of many different kinds. The ideal would be so to treat it as to bring it all to one standard for locomotive use, but that is impracticable. Most of the treatment plants are in the Middle and Far West, but of late they are being provided in the East. Where treatment is urgently needed it is an operating necessity as well as an economy because of the breakdowns untreated water would cause. By treatment these breakdowns have been reduced from hundreds a year on some lines to almost none at all. A century ago water tenders were barrels, filled by buckets. Hand pumps, horse power, windmills, steam and then gasoline successively were used for power. Now oil and electricity are largely used. Railway water tanks in 1870 had a capacity of 15,000 gal. Now 100,000-gal. tanks are common and some are much larger.

The Missouri Pacific, said J. B. Wesley, engineer water service, runs through nine states and uses a great variety of water—acid, alkali and muddy. It had 89 treatment plants in 1929. C. H. Koyl, engineer water service, Chicago, Milwaukee, St. Paul & Pacific, stated that it is now known that the purest iron will dissolve in the purest water—that is, corrosion is not due to acid only. Prevent the escape of hydrogen ions and corrosion is prevented. This is done by treatment with caustic soda; or a protective coating may be formed in the boiler tubes, as is done on the Chicago & Alton; or, as on the C.M.,St.P.&P., Mr. Koyl's method may be used: attach an open feed water heater, use a spray and prevent oxygen from releasing hydrogen from the boiler feed. R. C. Bardwell, of the Chesapeake & Ohio, said that by either volume and weight water is more extensively used by railways than is any other material.

Water-Borne Diseases and Other Dangers

Disproof of the feeling that water-borne disease has disappeared was offered at one of the general sessions by Abel Wolman and A. E. Gorman in the form of a summary of the records of the past ten years, the gathering of which with the aid of the engineers of the state boards of health is now well forward, with returns in from 41 states embracing 88 per cent of the population of the United States. It is expected that the whole country will be covered and it is hoped to cover Canada and Great Britain also. It should be understood that the study is concerned primarily with outbreaks (typhoid and "intestinal") due to water supplies and not with the yearly totals of these diseases. An apparent letting down by public health officials of attempts to control water-borne typhoid was noted by Mr. Wolman. Of 226 known water-borne disease outbreaks in the past ten years 67 were attributed to untreated surface waters, 54 to underground waters, 42 to purification plant faults and 31 to distribution systems. Small towns are no more responsible than large ones, in proportion to numbers. Some of the outbreaks were chiefly of dysentery and some were institutional. In Canada, raw river water was responsible for the greatest number of cases.

Private Cross-Connections—A generally overlooked contributing cause to such water-borne diseases as still occur, whether recognized outbreaks or not, was detailed in a paper on "Private Cross-Connections and Similar Menaces"—in the water-supply piping or plumbing of buildings—by Joel E. Connolly, chief, bureau of sanitary engineering, Chicago department of health. Of the many cited instances of pollution some of the worst were in public hospitals, where plumbing faulty in design led to the discharge of concentrated infective material into water supposed to be sterile.

S. B. Morris, Pasadena, Calif., said that his city has recently passed an ordinance which prohibits dangerous cross-connections in plumbing work. Previously it had not been necessary to get a plumbing permit before piping a building for water supply—which appears to be the case in other cities also. In closing the discussion Mr. Connolly said it is not so much in old as in new buildings, with their complex plumbing fixtures, that dangers from these cross-connections are found.

Disasters and Water Supplies—"Disaster Preparedness," also dealing largely with safeguarding water supplies, was a topic assigned to three members of the association. A paper sent by George W. Pracy, San Francisco, dealt chiefly with earthquake dangers. Pipe lines should be kept in solid ground, where possible, and away from fault lines. In filled ground, plenty of shut-offs should be provided. The personnel should be trained to meet energencies, S. B. Morris, Pasadena, Calif., said. All structures there are designed to meet earthquake conditions. Several Pacific Coast cities have made emergency action plans in conjunction with the American Red Cross. Disaster procedure ordinances have been adopted by Pasadena and Berkeley. Flood preparednness was taken up by John H. O'Neill, New Orleans. Floods rarely come without warning. Water supplies should be safeguarded. If chlorine is not used regularly, it should be held or brought into reserve, with chloride of lime as a possible substitute. Hurricane preparedness was outlined by F. L. Filby, Jacksonville, Fla., but he said that every state had its own variety of danger or dangers and that Delaware is the only state that has not at some time had relief work done in it by the Red Cross.

Training Operators for Small Purification Plants

The North Carolina method of training operators for small purification works was outlined by Prof. J. S. Whitener, Raleigh, N. C. formerly with the North Carolina health department. In essence, it consists of assistance by engineers of the department just named, especially when new operators begin their duties. The state universities co-operate through their courses in sanitary engineering. Abel Wolman, engineer, Maryland Board of Health, pointed out that the smaller cities, by consolidation of water, dairy and other work, can get trained men. E. S. Tisdale, engineer, West Virginia health department, reported that the university of that state is now co-operating in meeting the need under discussion. T. R. Lathrope, assistant engineer, Ohio health department, told of the use of part-time men in that state, who serve several municipalities. Trained operators are obligatory in Ohio, on demand of the state health authorities.

A new residual chlorine indicator and controller was described by J. W. Cutler, experimental engineer, Wallace & Tiernan, Newark, N. J., and Frank W. Green, Little Falls, N. J. (see *Journal* A.W.W.A., June, 1930). A working instrument has been in use at Little Falls for a short time.

Abstracts of some of the papers will appear in a later issue.—EDITOR.

International Building Questions Discussed at London Congress

Many Countries Represented—Rationalization, Financing and Contract Conditions Among Subjects Dealt With

Special Correspondence

ALTHOUGH building and the construction of public works is an industry of mainly domestic concern, largely independent of conditions in other countries, it includes many matters in which the experience of one country can benefit the others. Recognition of this fact probably was the motive that brought representatives of 35 nations to the Fifth International Congress of Building and Public Works, held in Central Hall, London, May 26-30. George Mowlem Burt presided.

The questions discussed at the congress were: (1) rationalization, (2) financial and credit facilities for the construction of middle-class houses and other buildings, (3) scientific research in building work, (4) standard conditions of contract, (5) workmen's houses, (6) apprenticeship and (7) safety measures.

Rationalization—Elimination of waste is the essence of rationalization, which was defined in the British report as "increasing the market for the products of an industry by reducing costs while at the same time increasing earnings—in other words, by consciously planning for maximum efficiency." The Swiss report described it as "a strife with involuntary and unseen waste." The most valuable contribution to the information made available came from the president, Mr. Burt, who showed how greatly building work can be speeded up and costs reduced by advance study of the work as a whole and the relation of the specialist work of subcontractors to one another and to the general progress of the work as a whole. Time schedules for the several types of work, to prevent interference, were mentioned and their value to the contractor and owner was shown. Representatives of the British government took part in the discussion. The Right Honorable J. H. Thomas put forward an earnest plea for rationalization as a means of reducing the unemployment problem confronting so many countries.

Co-operation in Industry—To show the value of developing a proper spirit of co-operation in industry, Robert D. Kohn described the activities of the New York Building Congress, of which he is president, in a contribution read in his absence. The aim of this organization to create an industry consciousness was shown by its establishment of a code of ethics for the entire industry and by the creation of an apprenticeship commission to organize training and technical instruction. Its efforts to reduce seasonal unemployment were much appreciated by the representatives of countries suffering from similar troubles.

Credit Facilities for Building—Discussion of building credits related mainly to middle-class houses, those costing $2,500 to $12,500 to construct. In Great Britain the government has provided subsidies to city and town councils to encourage them to erect the necessary houses which would have been erected by private enterprise but for war conditions. British banks were regarded as very backward compared with those of the United States and the Continental countries in giving credit facilities for important contracts. Building-loan societies have done valuable work in providing for construction of 2,500,000 homes in Britain through loans of a large proportion of the cost against repayment over periods of as much as twenty years.

European countries after the war were confronted with a gigantic problem in the provision of suitable accommodation for their manual and other ill-paid workers. In France the co-operation of private enterprise was stimulated and encouraged and many subsidy schemes and fiscal relief arrangements were devised, but in Great Britain everything was centralized through the activities of the local authorities and the rents of all housing property were controlled by rent restriction acts. The Builders Congress in Britain reported that the provision of houses could never be considered as a permanent function of the state or public authorities and called for the stimulation of private enterprise and the adjustment of the economic position to permit of its co-operation.

Education and Apprenticeship—Every country in the world seems to be suffering troubles through the dearth of adequately trained workmen and responsible officials; but earnest endeavors are being made to cope with the demand by encouraging employers to train apprentices and by arranging trades classes in association with the educational authorities. The system of presenting certificates and awards to exceptional workmen by the New York Building Congress, and the Swiss system of organizing a national certification scheme by the industry, aroused great interest at the meetings.

Conditions of Contract—Standard conditions to apply to all building contracts have received earnest consideration in many countries. The reports showed that France, Britain and Switzerland have recognized the need and have established schemes which are being used increasingly. In all of these three countries money is retained out of the sums due under the contract as a guarantee against defects.

In general the contractors feel that half of the retention money should be paid on provisional acceptance of the work and the other half should be retained only until the final settlement. Standard specifications have been drawn up in the United States by agreement between organizations of contractors and architects, while in Britain the National Federation of Building Trade Employers and the Surveyors' Institution have jointly prepared a "Standard Method of Measurement." These standards, however, are by no means in common use. In Switzerland payments are made monthly to the extent of 90 per cent of the value of the measured work and 80 per cent of other work, but in Britain, especially in contracts with public authorities, the architect or engineer has considerable discretionary powers in the matter of making interim payments, a practice which the contractors did not approve. One feature of British practice which was strongly objected to is that the architect or engineer is frequently made in effect the sole arbitrator on many matters relating to contracts.

Scientific Research—Lord Parmoor, president of the British department of scientific and industrial research, addressed the congress on the work the department is doing for the benefit of the building industry through the scientific study of the properties of materials and the methods of their utilization in actual construction.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Tests of Clay Tile Filter Bottom Blocks at Akron Sewage-Works

By A. B. Backherms
Sewerage Engineer, Akron, Ohio

IN designing the sewage-treatment plant for Akron, Ohio, a new type of floor, or underdrainage structure of clay tile, for the trickling filters, was developed by the engineers of the city in conjunction with the manufacturers. The tile structure is shown in Fig. 1, and consists of slotted cover blocks carried on hollow pier

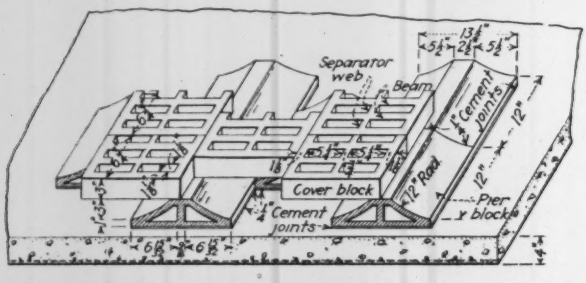


FIG. 1—FILTER FLOOR OF CLAY TILE FOR AKRON SEWAGE FILTERS

blocks. Before being adopted tests were made of the bearing power. Further tests were also made to establish a criterion in culling out blocks containing fire checks and cracks. These are the tests considered here.

Representative cover blocks were first selected and classified as: (1) perfect blocks; (2) blocks with cracked separator webs; (3) blocks with cracked center beam, and (4) blocks without fire cracks but slightly warped. All blocks were tested in a Riehle machine by applying

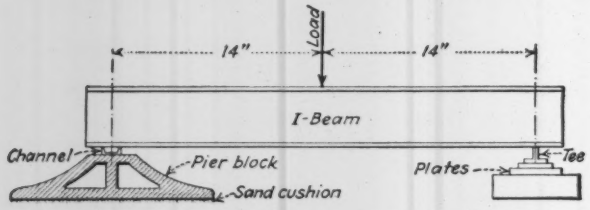


FIG. 2—DEVICE FOR TESTING FILTER FLOOR TILE

a concentrated load on a metal distributor along the center axis of the block, with reaction points similarly distributed. The tests for warped blocks were made by orienting the block so that the reaction or bearing points were across two diagonally opposite corners.

The breaking loads were converted to pounds per square foot to compute the comparative factor of safety with the following average results:

	Lb. Per Sq.Ft.
Perfect blocks	9,550
Blocks with one cracked separator web	5,240
Blocks with cracked center beam	3,910
Warped Loading	
Blocks without fire cracks	7,330
Blocks with separator web cracked	7,370

The pier blocks could not be so readily classified; consequently a variety of blocks were tested, as indicated in Fig. 2. The carrying load converted to pounds per square foot ranged from 3,460 to 5,360, producing a factor of safety of 5 for the good pier blocks. Obviously, to be consistent, all cover or pier blocks with a factor of safety of 5 or greater should be acceptable.

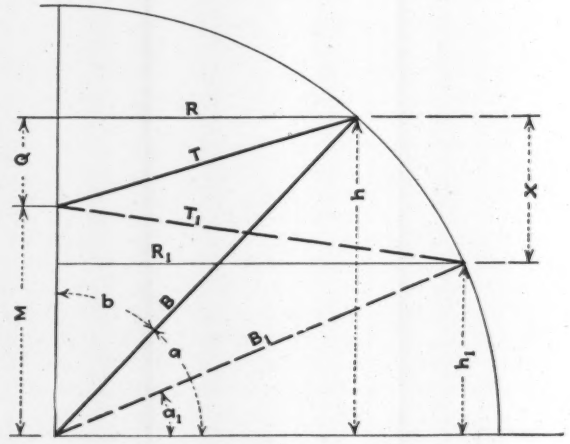
It was therefore concluded that all cover blocks with seriously checked beams or separator webs, or blocks with any of the three beams cracked or with both separator webs cracked should be rejected. For the pier blocks only perfect blocks or blocks with slight checks were accepted. On this basis, the combination in use produced a factor of safety of 5.

Formulas Give Length of Topping Lift for Changes in Derrick Boom Radius

By Donald M. McNeale
Secretary, Smoot Sand & Gravel Corp., Washington, D. C.

IT IS sometimes desirable to be able to determine the necessary amount of increase or decrease in the length of the topping lift of a stiff-leg derrick or any unloading device in which the topping lift is fixed in order to produce any desired lowering or raising of the end of the boom or decrease or increase in the radius, in a method other than by actual trial, which is rather expensive, inasmuch as it involves considerable labor and time. Recently an actual case of the kind came up in the operation of one of our derricks and I derived the following formulas which give the necessary values in terms of the length of the topping lift, boom and mast, all of which may be determined by the use of a steel tape.

M = mast
B = boom
T = present topping lift
T_1 = new topping lift
R = present radius
R_1 = new radius
h = present height of end of boom
h_1 = new height of end of boom



Derivation of formulas:

$$\text{Sin } a = \frac{h}{B}, \text{ or } h = B \sin a$$

$$\text{Sin } a_1 = \frac{h_1}{B}, \text{ or } h_1 = B \sin a_1$$

Subtracting:

$$h - h_1 = B \sin a - B \sin a_1$$
$$= B (\sin a - \sin a_1)$$

that is,

$$x = B (\sin a - \sin a_1)$$

According to the law of cosines, in an oblique triangle, $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$ where A is any angle, and a, b, and c are the sides, the side a being opposite the angle A.

As stated above, $x = B (\sin a - \sin a_1)$

Now, $\sin a = \cos (90 - a)$

Substituting:

$$x = B \left(\frac{M^2 + B^2 - T^2}{2MB} - \frac{M^2 + B^2 - T_1^2}{2MB} \right)$$
$$= \frac{M^2 + B^2 - T^2}{2M} - \frac{M^2 + B^2 - T_1^2}{2M}$$
$$= \frac{M^2 + B^2 - T^2 - M^2 - B^2 + T_1^2}{2M}$$
$$= \frac{T_1^2 - T^2}{2M} \qquad \text{Formula I}$$

From the law of cosines:

$$\cos b = \frac{B^2 + M^2 - T^2}{2BM}$$

also

$$\cos b = \frac{M + Q}{B}$$

Equating these equalities:

$$\frac{B^2 + M^2 - T^2}{2BM} = \frac{M + Q}{B}$$
$$\frac{B^2 + M^2 - T^2}{2M} = M + Q$$
$$Q = \frac{B^2 + M^2 - T^2}{2M} - M$$
$$= \frac{B^2 + M^2 - T^2 - 2M^2}{2M}$$
$$= \frac{B^2 - M^2 - T^2}{2M}$$

But $h = M + Q$

Therefore $h = M + \frac{B^2 - M^2 - T^2}{2M}$

$$= \frac{B^2 + M^2 - T^2}{2M} \qquad \text{Formula II}$$

$$R^2 = T^2 - Q^2$$
$$= T^2 - \left(\frac{B^2 - M^2 - T^2}{2M} \right)^2$$
$$= T^2 - \frac{(B^2 - M^2 - T^2)^2}{4M^2}$$
$$R = \sqrt{T^2 - \frac{(B^2 - M^2 - T^2)^2}{4M^2}} \qquad \text{Formula III}$$

Note: As a check on results, h and R can be measured with a steel tape.

Example

Assume $T = 40$ ft. $B = 60$ ft.
$M = 35$ ft. (Then R may be either measured or computed.) (Say, 33 ft.)

To find new length of topping-lift in order to increase radius by 4 ft.

$$B^2 = (R + 4)^2 + h_1^2$$
$$(60)^2 = (37)^2 + h_1^2$$
$$h_1^2 = (60)^2 - (37)^2 = 2{,}231$$
$$h_1 = 47.2 \text{ say } 47 \text{ ft.}$$

Now h can be either measured or computed (say, 50 ft.).

From case I

$$x = \frac{T_1^2 - T^2}{2M}$$

Substituting

$$3 = \frac{T_1^2 - 1{,}600}{70}$$
$$210 = T_1^2 - 1{,}600$$
$$T_1^2 = 1{,}810$$
$$T_1 = 42.5 \text{ ft.}$$

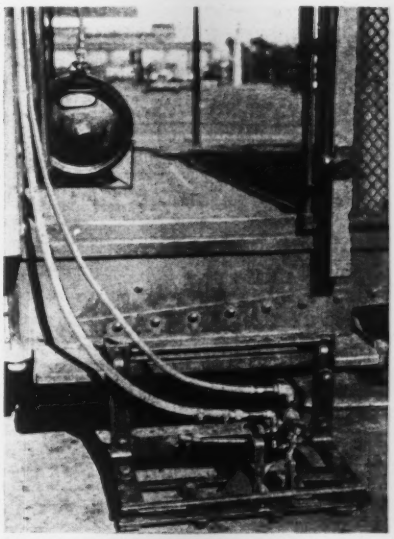
To find the length of the new topping-lift in order to lower the end of the boom 7 ft.

$$7 = \frac{T_1^2 - 1{,}600}{70}$$
$$490 = T_1^2 - 1{,}600$$
$$T_1^2 = 2{,}090$$
$$T_1 = 45.7 \text{ ft.}$$

Line at Side of Street-Car Tracks Shows Clearance for Parking Autos

THE careless parking of automobiles, which results in a slight infringement of street-car clearance with subsequent delays in service, caused the Municipal Railway of San Francisco to paint lines along the tracks to indicate such clearance. Most infringements were occasioned by drivers who unintentionally left their cars overlapping a few inches, and the line was considered an aid to traffic rather than as a restrictive limit. Results, according to G. D. Burr, city traffic engineer, have been gratifying to both drivers and motormen.

The painting machine is attached to the front step of a street car and operated by air from the air-brake compressor. Yellow lacquer is used, applied as a spray and followed by a brush. The machine operates at a rate of 7 to 8 miles per hour and the work is done at night during the hours of least traffic. Cost of the paint line varies from 0.7c. to 1c. per linear foot per application, and repainting is required at intervals of about three months. The cost of the painting is reported to be more than offset by the saving in delays in street car operation.



MACHINE PAINTING LINE ALONG CAR TRACKS

The machine was designed and constructed in the shops of the San Francisco Municipal Railway under the supervision of Mr. Bendel.

Stop Watch Increases Accuracy of Astronomical Observations

By Harry Tucker
Professor of Highway Engineering, State College of Agriculture and Engineering, Raleigh, N. C.

COURSES in field astronomy given in technical colleges usually cover the methods for determining latitude, azimuth, time and longitude. For the surveyor the determination of latitude and azimuth are the most important from a practical viewpoint. However, in teaching field astronomy, it is desirable to be able to make the observations and to solve the problems involving time and longitude. And it is with these prob-

lems that it is so necessary to obtain the exact time of making the observation.

With a reasonably accurate watch, a reading glass and a stop watch, my students in field astronomy have been able to obtain remarkable results in determining time and longitude, using an ordinary transit for making the observation. The procedure is as follows: About an hour before the observation is made the watch error is determined from a Western Union clock or over the radio. A few minutes before the time signal is given, the stop watch is set with the second hand of the ordinary watch by aid of the reading glass. When the hourly gong sounds, the stop watch is instantly pressed. Its reading gives the watch error. In making the observation, the stop watch is again set with the second hand of the ordinary watch. The observer holds this in his hand and presses it at the instant of making the observation. The time can then be read to at least 0.2 second.

Railing and Ladder Safeguards for Canals of Kittitas Project

SAFEGUARDS of several types are used in the main canal on the Kittitas division of the Yakima irrigation project in Washington: (1) Angle-iron railings are placed around the operating platforms of siphons and on the sides of bridges crossing the canal; (2) heavy timber fences are built along the edges of the canal at both inlet and outlet ends of siphons and tunnels to decrease the danger of persons or stock falling into the canal, (3) metal ladders are placed on alternate sides of the lined canal at 250-ft. intervals and (4) creosoted timber floats fastened to a 1-in. guide rope by means of J-bolts and a short length of ½-in. chain to posts of the heavy railing are installed at the inlet of each siphon and tunnel.

Three of these safeguards are shown in the accompanying illustration: In the foreground are the angle-iron railings protecting the operating platform on a siphon inlet; the heavy timber guard railing protects the near-by portion of the canal; and the metal safety ladders to provide means of escape from the canal itself appear on either side of the man standing on the canal bottom.

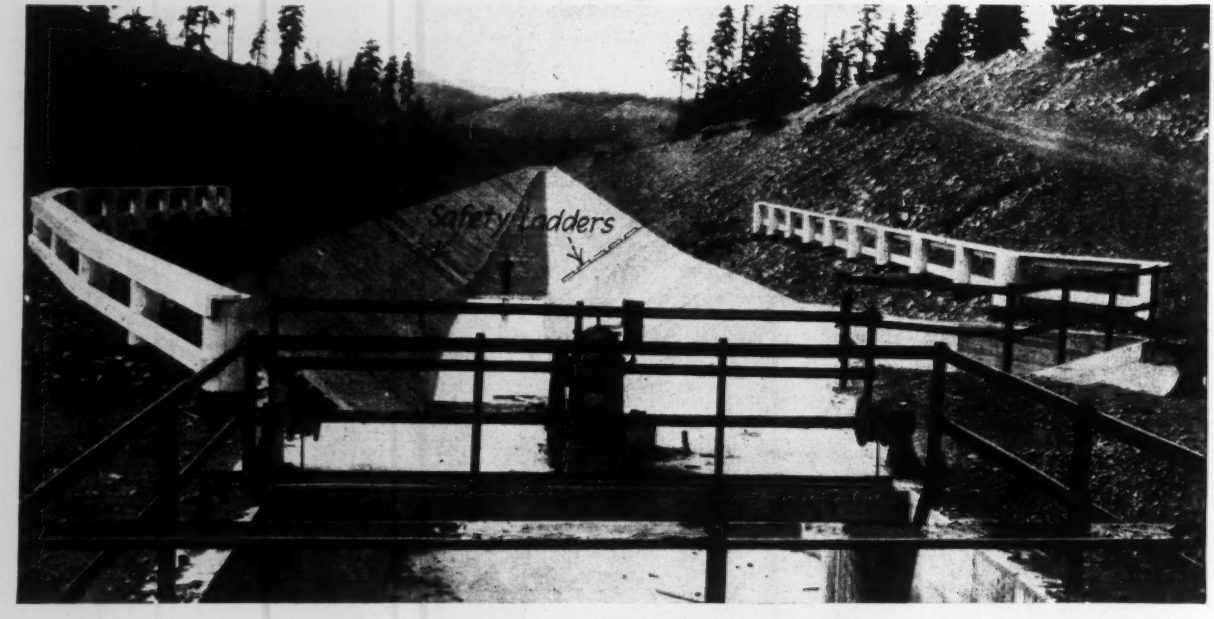
When the canal is carrying water it will be almost impossible for a person without aid from the bank to climb the 1¼:1 side slope of the concrete lining. It was considered desirable, therefore, to provide the safety ladders. They are placed on alternate sides of the canal on 250-ft. spacings except at the entrance to a siphon or tunnel, where ladders are placed opposite each side of the canal.

The ladder rungs are made of ¾-in. round metal, spot-welded into a ½x3-in. strap. The rungs are 4 in. high by 2 ft. long and are placed lengthwise of the strap on 2-ft. 8-in. centers. Each strap has two to five rungs, depending upon the depth of the canal lining. The ladders are fastened to the concrete side slopes by bolts grouted into the lining 2 ft. 8 in. apart.

The timber float just above each siphon or tunnel intake is the last means of aid for a person floating down with the current. It is not believed that a person could survive a trip through even the shortest of the siphons.

Job and Office Note

FEW DRAFTSMEN KNOW that the parallel straight-edge attachment, now in general use, can easily be adjusted for drawing views or projections at an angle. Ordinarily, the draftsman does this work with triangles, which are not very accurate and which require more time than when working from a horizontal line. The parallel straight-edge can be pulled around to any angle from 1 to 30 deg. When this is done, the cord which extends along the top of the drawing board moves laterally. An indicating scale can easily be scribed on the board so that, when occasion arises to show a view at an inclination, the draftsman can pull the straight-edge around to the desired angle as determined by the scale and hold the cord in position with a thumbtack, working in the same manner as if from a horizontal line.—MORTON SCHWAM, Philadelphia, Pa.



THREE OF THE FOUR SAFEGUARDS USED ON YAKIMA CANALS
Railing made of angle iron, heavy timber guard rails and safety ladders for climbing out of the canal.

News of the Week

House Passes Bill to Reorganize Power Commission

Reorganization of the Federal Power Commission appears to be a certainty. On June 9 the House passed, 201 to 17, the Parker bill to transform the present commission into a board of five members to serve full time at a salary of $10,000 a year each. The commission is now made up of the secretaries of the interior, agriculture and war, and the claim is made that these secretaries, with their other duties, cannot give the time necessary. The Senate has already passed a similar bill, but the Senate bill calls for only three commissioners. It is expected that the difference can be adjusted in conference. Opposition to the bill was based upon alleged duplication of facilities and interference with War Department jurisdiction over navigable streams.

O. A. Kratz Appointed City Manager of Covington

Oscar A. Kratz, city manager of Dubuque, Iowa, has been appointed city manager of Covington, Ky., to succeed J. Franklin Bell, whose resignation was asked for and received, as announced in *Engineering News-Record*, May 29, 1930, p. 510. Mr. Kratz is a graduate of Michigan State College, and during the construction of the Panama Canal had charge of engineering work in the cities of Colon and Panama. He also served six months as sanitary engineer under Colonel Gorgas. He will receive a salary of $12,000 a year, made up by the donation of the salaries of $3,000 each of four of the five commissioners.

Army Engineers Hear Renewed Pleas for Hudson River Bridge

Approval Requested for Lindenthal's Proposed Span at New York—Three Plans Presented

MEETING in New York City on June 4, a special board of army engineers consisting of Colonels G. M. Hoffman, G. B. Pillsbury and Harley B. Ferguson heard the testimony of a number of witnesses for and against the proposed construction of a railway-highway suspension bridge across the Hudson River at 57th St., New York City. Three possible plans for the structure were submitted by the applicant, the North River Bridge Co., of which Gustav Lindenthal is president and chief engineer. All of these have towers within the pierhead lines, but differ in the clearances allowed above mean high water, summarized in the following table:

Minimum Clearance:	Proposed Plan	First Alternative	Second Alternative
For a width of 300 ft. at center	184.8	175.8	179.8
For a width of 1,000 ft. at center	180.8	172.2	175.9
For a width of 1,700 ft. at center	172.1	164.8	168.0
At N. Y. pierhead line	160.3	154.8	157.3
At N. J. pierhead line	157.3	151.9	154.3
Railroad grade necessary (per cent)	3.00	2.69	.....

The bridge company's arguments were presented by Francis Lee Stuart, consulting engineer, who requested the War Department to approve that one

(Continued on page 990)

Thirteen Men Killed in Two Tunnel Explosions

Six men were killed and six were injured in an explosion June 9 in the nearly completed water intake tunnel under the Detroit River. The explosion took place about 180 ft. below the surface of the river. Preliminary investigation indicates that a charge of dynamite which had failed to explode Sunday morning, when the night shift shot a section of the heading and bench, was set off by the day shift about 10:30 a.m. Monday while mucking and clearing the bench. There were 36 men in the tunnel when the explosion occurred, but the survivors rushed to the elevator and were taken to the surface.

Seven men were killed and an eighth was injured seriously on June 9 when natural gas which had seeped into the Calaveras tunnel exploded while workers were hastening completion of San Francisco's new water system. The tunnel is about a mile underground at the point where the explosion occurred. Officials of the San Francisco water department, owner of the Hetch Hetchy water system, of which the Calaveras tunnel is a part, said that a pocket of natural gas was probably ignited by a workman's drill.

Boston Bridge Burns With $1,000,000 Loss

The L St. bridge, connecting South Boston with Boston proper, burned on June 6 with a loss estimated at about $1,000,000. Plans are being prepared for immediate rebuilding, which will require a new structure.

Wide World Photos

NEW SOUTH SHORE BRIDGE, SPANNING THE ST. LAWRENCE RIVER AT MONTREAL

Dedication and official opening of this bridge connecting Montreal with the South Shore, took place on May 24, a year and a half in advance of the predicted date. The total length of the bridge is 11,236 ft., of which 8,803 ft. is steel bridge work and 200 ft. concrete viaduct. Clearance under the central span at high water is 160 ft. A feature of the bridge is the 1,097-ft. cantilevered span of K-truss design from St. Helen's Island pavilion to the Montreal south shore ramp. A long series of simple deck-truss spans serve as approaches from either side. In the superstructure 33,267 tons of steel was used. The contractors on this structure were Quinlan, Robertson & Janin, Ltd., the Dominion Bridge Co., Ltd., and the Dufresne Construction Co., Ltd.

Pleas for Hudson River Bridge

(Continued from page 989)

of the three plans submitted which would give the lowest railroad grade with due regard to necessary clearance for navigation. Mr. Stuart quoted letters from H. A. Lane, chief engineer, and J. H. Clark, general superintendent of motive power of the Baltimore & Ohio Railroad, pointing out that requirements of reasonable cost and safety limit the grade on the bridge to a maximum of 3 per cent, with a lesser grade highly desirable. Mr. Stuart estimated that the traffic over the bridge would amount to over 400,000,000 tons per year, including many millions of passengers. The convenience to traffic over the bridge, he contended, should be balanced against the relatively slight embarrassment which might result to a small proportion of the traffic passing under the bridge.

Going further into the matter of necessary clearance, figures were given showing the heights of masts and funnels of the larger passenger liners. While admitting that some of these would be unable to pass under the structure, Mr. Stuart presented figures from shipbuilders offering to install a telescoping arrangement on the upper masts of such ships at prices ranging from $3,000 to $8,000 each. The bridge company holds itself ready to pay the expense of installing such an arrangement on any ship upon which it proves necessary.

D. B. Steinman, consulting engineer, quoted letters received from a number of shipbuilders stating that the present tendency is to reduce the mast heights of ships. He also cited the enormous economic waste in all parts of the world caused by erecting bridges higher than necessary. The present decision, according to Mr. Steinman, will create a precedent to be followed in the future and present an excellent opportunity to establish a standard clearance for all similar bridges.

Capt. T. H. Taylor, representing the commandant of the 3d Naval District, stated that any of the three clearance heights proposed would be satisfactory to the navy, inasmuch as all naval vessels are now equipped so as to pass under the Brooklyn bridge, with a clearance of 132 ft. In his opinion, a standard clearance of 160 ft. over navigable waters would be acceptable to the U. S. Navy.

The views of the Port of New York Authority were presented by J. G. McGuire, Jr., engineering assistant. The Port Authority holds that interstate crossings must be planned and carried out with proper regard for the rights of navigation, the requirements of traffic, and timeliness from a financial standpoint. Facilities provided by the Holland tunnel, the Fort Lee bridge and the proposed tunnel under the river at 38th St. will be sufficient, in its opinion, to care for all vehicular traffic until 1940. A fourth crossing will probably be necessary about 1945, the exact location of which will be subject to later determination. Should a bridge be constructed at 57th St., rapid transit trains could make use of it, but the construction of a bridge is not essential, as an independent crossing can readily be provided. From the standpoint of freight transportation the Authority pointed out that since the center of freight activity on Manhattan Island is now at Canal St. and the center of railroad terminal activity on the Jersey side about opposite Barclay St., the new bridge would provide a longer route than the Holland tunnel, the 38th St. tunnel or existing ferries.

Arguments in opposition to the construction of the bridge included the effect on traffic congestion, business, and real estate values, held to be detrimental by the Fifth Avenue Association; and the feeling of several bodies that cross-river traffic should be cared for by tunnels rather than by overhead structures.

Details of Folsom Dam Contract Announced

The final draft of the Folsom dam lease contract which has been submitted to the American River Hydro-Electric Co., of San Francisco, sponsor of the $11,000,000 development on the American River, has been made public. In consideration for the 50 years' lease to the company, the state under this plan would receive: a cash payment of $25,000; free power and water for irrigation and domestic uses at Folsom prison; flood control for North Sacramento at a nominal cost to the state and salinity control of the lower Sacramento; fee simple title to the land in the dam reservoir; right of recapture for the state or any political subdivision at any time during the life of the lease, and absolute title to the entire project at the end of 50 years.

The state agrees in the contract to pay $600,000 for building the flood-control works in the dam, which will be 390 ft. high and have a reservoir capacity of 355,000 acre-ft., 175,000 of which would be reserved for flood control.

To Survey Arkansas River for Irrigation and Flood Prevention

A survey of the Arkansas River, with a view to conservation of waters for irrigation and flood prevention, is to begin this month following authorization by army authorities for M. C. Hinterlider, Colorado state engineer, to employ two civilian engineers who will work in conjunction with J. H. Neff, army engineer in charge of Western survey work. Part of the study will center on the proposed Caddoa dam, east of Las Animas, Colo., contemplated for the double purpose of impounding irrigation supplies and relieving the menace of floods.

Water users of the Arkansas Valley have matched a state appropriation of $10,000 for this survey.

Funds Allotted for Flood Control and River and Harbor Work

Major-Gen. Lytle Brown, Chief of Engineers, has made the following allotments from funds appropriated in the War Department appropriation act approved May 28, 1930, for the prosecution of flood control in the alluvial valley of the Mississippi River, in accordance with the provisions of the flood-control act of May 15, 1928:

To the District Engineer, Memphis, Tennessee:	
For levees	$4,341,000
For revetments	2,300,000
To the District Engineer, Vicksburg, Miss.:	
For levees, Mississippi River	$6,015,000
For levees, south bank Arkansas River	2,000,000
For revetments	1,600,000
To the District Engineer, 2d New Orleans District, New Orleans, La.:	
For levees	$4,170,000
For Bonnet Carré spillway	2,274,000
For revetments	1,500,000

The secretary of war has approved, among others, the following allotments for river and harbor work recommended by General Brown under the provisions of the War Department appropriation act:

Hudson River, New York	$1,125,000
Delaware River, Philadelphia to the sea	3,380,000
Louisiana-Texas intracoastal water way, New Orleans-Sabine River section	1,960,000
Same, Sabine River-Corpus Christi section	1,289,000
Mississippi River, between Ohio and Missouri rivers	1,700,000
Between Illinois and Wisconsin rivers	1,700,000
Between Wisconsin River and Minneapolis	1,185,000
Missouri River, Kansas City to Sioux City	2,250,000
Ohio River open-channel work	1,640,000
St. Mary's River, Michigan	1,881,000

Preliminary Work on Plans for New York-Weehawken Tunnel

Preparation of a definite report, with recommendations to the legislatures of New York and New Jersey on the proposed vehicular tunnel between New York City and Weehawken, has been launched by the reorganized Port of New York Authority with the adoption of a plan of procedure. The plan, which will carry out the legislative mandate directing the Authority to submit a comprehensive report next winter on the proposed tunnel, will include topographical surveys; borings; negotiations with municipal and other officials on highway approaches and connections; design studies, including type and proportions, ventilating systems and method of construction; and determination of requirements of the War Department with respect to the depth of the river tunnel. The probable cost of the project will also be determined, together with the best method of financing construction.

Hudson River Bridge Approach Contract Awarded

The contract for the New Jersey approach excavations and miscellaneous construction on the New Jersey end of the Hudson River bridge between Fort Lee and Manhattan has been awarded to George M. Brewster & Sons, Inc., of Bogota, N. J. The Brewster bid was $287,651.50. The highest bid was $543,655.

Americans on International Commission on High Dams

In response to an invitation by the French government, the State Department has designated three Americans as members of the International Commission on High Dams. They are: O. C. Merrill, Washington, chairman of the American committee, World Power Conference; Henry J. Pierce, New York, vice-chairman of the same committee; and L. F. Harza, Chicago, member of the executive committee of the power division, American Society of Civil Engineers.

Oakland Citizens Petition for Vote on City Manager

More than 21,000 signatures, a greater number than is required by law, are affixed to petitions seeking to place a measure for a charter amendment on the ballot at the election in August changing the municipal government of Oakland, Calif., from the existing commissioner system to the city manager form. The petition will be presented to the city council this week. A check-up of citizens, according to those who have the matter in hand, shows considerable sentiment in favor of the change.

Cement Prices Bring Protest From South Carolina

Bids received by the State of South Carolina on May 15 for 1,000,000 or more barrels of portland cement for highway purposes have led to the publication of a statement by C. E. Jones, chairman of the state highway commission, protesting against certain practices in the industry. The proposals of all American manufacturers, according to Mr. Jones, were identical, being equivalent to a unit base price at Charleston, with freight from this point to place of delivery added. Assuming, as an example, the cement to be shipped from Birmingham, Ala., this would result in a net return to the producer varying from 87c. to $1.50, according to place of delivery. While recognizing that this is neither a new practice nor one confined to the cement industry, Mr. Jones sees no justification for such a variation on the prices charged for the same article for use in different parts of the state.

Surprise is also exhibited at the fact that the prices submitted are identical to those quoted to dealers purchasing lots of a single carload, despite the large quantity to be purchased and the fact that the transaction involves practically no sales cost and no credit risk whatever.

The commission, according to the statement, has under consideration alternate plans involving erection of its own cement mill, leasing of an existing mill, construction of a mill by private capital or abandonment of concrete as a standard paving type.

Jubilee Convention of Water-Works Men Held at St. Louis

American Water Works Association Has Registration of Over a Thousand—George H. Fenkell New President and Eight Honorary Members Elected

WITHOUT blare of trumpets but with fitting recognition of the fact that it was holding its 50th annual convention, the American Water Works Association met at St. Louis, Mo., June 2 to 7. The official registration was 1,018, including guests. The choice of St. Louis was happy, because it was there, in March, 1881, that the association had its birth. The choice was also happy because St. Louis well illustrates the progress of water-works practice in a half century. This is particularly true of water treatment, still in its crude beginning in this country 50 years ago and not gone far into at St. Louis until the present century was well advanced, although in the '60s St. Louis sent James Kirkwood to Europe to study filtration there. The city now has two large purification plants, one of which is new.

The history and progress of the American Water Works Association was reviewed and tribute to its pioneer members was paid by President Hinman in his address, summarized in the report of the technical proceedings of the convention beginning on p. 980 of this issue.

Veteran and Honorary Members

The jubilee of the association was further recognized in two ways: Special badges were sent in advance to the veterans of the association—members of at least 30 years standing; and an unusual number of honorary members were elected. The eight honorary members need no other specification to the engineering and water-works fraternity than their names: John W. Alvord, George W. Fuller, Allen Hazen, Prof. Daniel W. Mead, Col. Dabney H. Moury, Prof. A. N. Talbot, Robert Spurr Weston and X. H. Goodnough.

Another form of recognition to a living member, in honor of one deceased, was the award of the Diven memorial medal to R. L. Dobbin, superintendent of water-works, Peterborough, Ont., for his contribution to the progress of the association in framing its new constitution.

A healthy financial condition and an unusual growth of membership were shown by reports for the past year. Receipts totaled $66,000, with a good balance in hand. The permanent fund was increased to $21,000. A budget of over $67,000 for 1930-31 was adopted.

Membership Campaign Successful

Membership now totals 2,843: active, 2,387; corporate (cities, water companies, state health departments, etc.), 216; associate (manufacturers and supply dealers), 227; honorary, 12. More than 400 new members have been added since Jan. 1, thanks to a membership drive led by Arthur E. Gorman. A goal of 500 new members has been set. The Nicholas S. Hill, Jr., cup for largest percentage increase in membership during the year was won by the Southeastern section, for a 56 per cent increase. The largest actual gain, 48, was recorded by the California section.

New General and Division Officers

The new president of the association is George H. Fenkell, superintendent and general manager of the Detroit water-works. The office of treasurer will continue to be filled by W. W. Brush, chief engineer, department of water supply, New York City. There were no opposing candidates. Under the new constitution these are the only officers elected by the entire membership of the association. Each of the eighteen geographical sections chooses its own officials and elects one member of the board of governors. The three technical divisions elected officers as follows:

Finance and Accounting—Chairman, Hal F. Smith, Detroit; vice-chairman, A. R. Michael, Orlando, Fla.; secretary-treasurer, H. Gordon Calder, 27 William St., New York City.

Plant Management and Operation—Chairman, Stephen H. Taylor, New Bedford, Mass.; vice-chairman, Ray Crozier, Peoria, Ill.; secretary-treasurer, A. V. Ruggles, 29 West 39th St., New York City.

Water Purification—Chairman, John R. Baylis, Chicago; vice-chairman, Paul Hansen, Chicago; secretary-treasurer, Harry E. Jordan, Indianapolis Water Company.

Next Meeting Place Not Announced

Announcement of the next meeting place of the convention was postponed for further deliberation by the board of directors. Claimants for the place were Detroit, Philadelphia and Pittsburgh, the latter urging that the association had never met in that city.

In accordance with the new constitution, each member and guest recorded as present paid a registration fee of $5, which covered admission to the smoker and dinner dance.

The exhibit of water-works appliances and materials was large and well arranged. The proceedings of the Water Works Manufacturers Association are reported separately on p. 995. Except for one afternoon set aside for a general visit to the new Howard Bend pumping and treatment plant of the St. Louis water-works, there were no excursions, thus leaving the time for technical sessions. None of the latter was held in the evening—probably for the first time in the 50 years' history of the association.

Toronto Has Comprehensive Plan for Traffic Relief

An important plan of development for Toronto, Ont., came before the city council recently and received tentative approval. The plan, which is only an outline, provides for the growth of Toronto to twice its present size. The traffic needs of Toronto up to 1,500,000 population would be dealt with under a very broad plan in the creation of through trafficways by the opening of new streets and the widening and extension of other thoroughfares. The plan was presented by the advisory planning committee of departmental heads, which early in the year was charged with the responsibility of bringing in such a report. The cost of carrying out the plan has not yet been estimated.

Library on Highway Transport Organized

Announcement of the organization of a library on highway transport has been made by Thomas H. MacDonald, chairman of the Highway Education Board and chief of the U. S. Bureau of Public Roads. The library will be for the use of engineers, economists and others interested in highway transportation and related questions. As the Highway Education Board has long been interested in the progress of highway construction and highway transport in Latin America, a special feature of the library will be the Latin American section, where books and magazines in both Spanish and Portuguese will be at the disposal of visitors from Central and South America. The library will be open to all persons desiring to make use of its facilities.

San Mateo Flying School Base Greatly Improved

Major improvements recently completed at the Curtiss-Wright Airport, San Mateo, Calif., include the leveling and grading of 5,000,000 sq.ft. in the center of the 375-acre flying field, providing an all-way landing area. Two cross-runways, 500 ft. wide and 3,000 ft. long, have been completed. Boundary, flood and beacon lights have been installed in accordance with Department of Commerce regulations and the administration building has been completed. Space for 30 airplanes is provided on the concrete floor of the hangar, which is 102x120 ft.

Baltimore Extends Water Supply

The city of Baltimore has purchased the Dundalk Water Co., Dundalk, near Baltimore, for $197,805.62, and has paid the initial $25,000. The mains of the city system are to be extended to join those of the Dundalk company, and city water will be supplied to Dundalk and Logan Field, the municipal airport.

Dr. Compton Heads M.I.T.

Dr. Karl Taylor Compton was inaugurated eleventh president of Massachusetts Institute of Technology June 7 before a distinguished gathering. A noted scientist, research student and con-

Left—Dr. Compton
Right—Dr. Stratton

tributor to pure and applied physics, Dr. Compton succeeds Dr. Samuel W. Stratton, who retires to become chairman of the corporation of the institute. In his acceptance of the post, Dr. Compton pledged his abilities and energy to strengthening the relationship between technology and industry, and in addition to promoting higher standards of excellence through carefully prepared courses in fundamentals arranged by a faculty of high selective ability.

The Business Outlook

As the last month of the second quarter begins, the rate of business recovery has slackened and the prospects of early return to normal levels are less hopeful. Our comprehensive business index, at 92.7 per cent, is farther below normal than it has been at any time since February. Commodity prices are still declining and business recession is worldwide.

The decline in steel operations during May has been at about the same rate as in 1928, but it now looks as though the hope of fairly well sustained activity during the summer has faded. Electric power production continues to run practically at last year's level. Bituminous coal production increased for the week and is following closely the usual season trend. The latest week is practically at the 1928 level.

—The Business Week, June 11.

Laboratory Research Plans by Lumber Association

Final plans for carrying on the program of laboratory research recommended by the technical advisory committee at the annual meeting of the National Lumber Manufacturers' Association have been worked out, and the research will proceed as funds permit. The work will be done by the trade extension department, and includes the following program: fundamental investigations of moisture-proofing, fire-retardant treatment and shrinkage-prevention processes, together with supplementary mechanical testing; tests of built-up laminated structural members and timber-framing details, of laminated and plank bridge and factory floors, of strength and rigidity of joisted floors, of heat transmission of wood and of lumber walls, of floor abrasion, hardness and slipperiness, and of lath and plaster; fire tests of columns, doors, windows, partitions, floors, elevator doors and scaffolds.

New Course in Business Training Announced at M.I.T.

In recognition of the growing demand for technically trained men in the field of business management, the Massachusetts Institute of Technology will institute next autumn a separate department of undergraduate and graduate instruction in business training with an engineering background as a preparation for management in commerce and industry. The undergraduate course will lead to the degree of bachelor of science, and graduate courses will be started permitting a student holding an engineering degree from an accredited institution to obtain a master's degree in business and engineering administration by completion of work given in summer session and in a subsequent graduate year.

Credit Practices Considered at Meeting of Contractors

Definite steps to check loose credit practices in the construction industry were taken at a meeting of representatives of the Associated General Contractors of America, the National Building Supply Dealers' Association and nearly a score of nationally organized subcontractor groups, June 5 and 6, at Cleveland, Ohio. Co-operative utilization of both selling and buying power in the enforcement of standard credit policies, through the bringing together of all existing associations, both local and national, to curb unwarranted extension of credit, is the basis of the plan proposed. Among the subjects taken up at the meeting were: methods of financing the promotional work; the exchange of delinquent account information on a national basis; and the preparation and training of promotional and operating executives for the new credit stabilization movement.

Brief News

SEALED BIDS for furnishing approximately 100,000 bbl. of American portland cement will be opened June 20 at the U. S. Engineer office at Memphis, Tenn. The material will be used on revetment work on the Mississippi River at Cairo and at the mouth of the White River.

DANISH RAILWAYS in Seeland, near Copenhagen, will be electrified within the next four years at a total expenditure of approximately $14,000,000.

AERIAL SURVEYS of the far Canadian north, to be carried out by the federal government, are announced. An airplane base is to be established at Fort Resolution.

CONSTRUCTION of the Halifax airport began on May 15, the contract, involving $101,175, having been awarded to the firm of Hanratty & Bianco, of Halifax.

HARBOR RECONSTRUCTION at Dunkirk, France, amounting to approximately $11,000,000, will be executed by two German contracting firms as a part of the reparation account. The work is expected to extend over five years.

ALL COUNTY BRIDGES on state roads in Pennsylvania were taken over by the state highway department on June 1. There are 2,127 of these bridges, and the department has an extensive program of repairs and replacements under way.

PANAMA CANAL TRAFFIC declined in May until the daily average of transits of 15.16 ships was the lowest since June, 1927. The total tolls collected in the first eleven months of the present fiscal year were $23,675 less than for the same period in 1929.

BATTLEDECK TYPE OF FLOOR CONSTRUCTION will have its first practical application at Pittsfield, Mass., in a garage addition. This new flooring consists of steel plates welded together by self-propelled automatic welding machines.

DELIVERIES OF NATURAL GAS to Lincoln, Neb., through the new pipe line from the Panhandle field of Texas will begin Aug. 1, according to present plans. This line, when completed, will be 1,000 miles long and will supply many cities in Iowa and Nebraska.

A GERMAN COMPANY has secured a contract for the construction of a railway from Parana, Argentina, to Maria Grande, and for the improvement of the port at a total cost of more than $6,000,000.

ELECTRIFICATION of Spanish railways has been postponed by the Spanish government for two to three years, owing to financial stringency. The government had asked for bids, and among those submitting them were three American concerns.

STEPS ARE BEING TAKEN to inaugurate a twelve-year channel-improvement program at Rouen, France, which will include dredging, deepening and widening the River Seine, to allow ships of at least 25-ft. draft to enter at any tide. The project will cost approximately $110,000,000.

CONSTRUCTION OF A TUNNEL between England and France has been vetoed by the committee of imperial defense, Premier MacDonald presiding. On the French side, Calais and other northern French ports are fighting plans to build the tunnel because they believe it would kill their water traffic.

THE BENBOW POWER CO. has been authorized by the California Railroad Commission, in a supplemental order, to execute a mortgage or deed of trust securing payment of $130,000 of 6 per cent first mortgage bonds heretofore authorized, for the development of its power project at Benbow, Calif.

WASHINGTON NOTES

By PAUL WOOTON
Washington Correspondent

General Brown Gives Views on Mississippi Flood Control—Boulder Dam Contracts Approved

HEARINGS in progress before the flood-control committee are for the purpose, Chairman Reid explains, of rounding out the picture of the situation as it exists so that it may be studied by members of the committee during the summer. This will make it possible for them to deal more intelligently with the reports of the engineers which will be presented at the next session.

In addition to hearing General Brown and General Jackson, the committee has requested all district engineers on the river to come to Washington to testify. After the engineers have completed their testimony, representatives of governors, mayors, levee boards, flood-control associations, land owners, railroads and others affected will be heard.

Referring to a telegram from J. P. Kemper, of New Orleans, chairman of the deposed appraisal commission, protesting against statements that the appraisers in the Bonnet Carré spillway area set too high a price on the land to be condemned, Representative Stone stated that there can be no doubt that the Department of Justice is convinced that systematic efforts are being made to exact unreasonable prices from the government for the land condemned at Bonnet Carré.

Use of Reservoirs Possible

Representative Sears continued his questioning of General Brown in regard to reservoirs. General Brown stated that he is awaiting the completion of the reservoir study with an open mind and that he will not hesitate to recommend the use of reservoirs where they are feasible. He expressed the opinion that some use of reservoirs will be made in connection with the flood-control program. Doubt was expressed by General Brown as to the advisability of building a high dam in the Arkansas. He said the question of the accumulation of silt in such a dam is under study at this time.

Resuming his examination of General Brown, Representative Driver asked him if reservoirs in the Arkansas and White river basins would make it possible to eliminate the diversions on the west bank. General Brown replied that in his opinion the Boeuf floodway could be eliminated were reservoirs built, but that the Atchafalaya diversion will still be necessary. As to the advisability of regulating and controlling the diversions, General Brown said that this matter is conditional upon the construction of control dams in the White and Arkansas rivers. If reservoir control is effected in the basins of these tributaries, regulation of the Atchafalaya diversion would be desirable in many respects, he said.

Concerning Fuseplug Levees

Representative Driver next asked General Brown to state his views concerning the practicability of the fuseplug levees. General Brown asked that he be excused from committing himself definitely in this respect until he has obtained further facts. He stated, however, that as a general principle he prefers a diversion that will be hydraulically perfect. Such a diversion will permit a definite amount of water to be taken from the river, he said. He added that a regulated diversion would be able to accommodate a larger amount of water and would therefore tend to reduce the backwater areas.

Speaking further of the general principles that he thinks should be applied to diversions, General Brown told the committee that a narrow floodway, with confining levees and a cleared path in between, has many advantages over the unregulated type. He said that he would not necessarily favor the construction of control gates at the heads of the west side diversions similar to those that are being built at Bonnet Carré. Adequate control could be secured through the use of an elevated sill, he stated. In commenting upon the relative needs of the various parts of the valley for protection, he asserted that New Orleans should be accorded prior consideration.

Flood Control in Florida

While the House flood-control committee is considering amendments to the Mississippi flood-control act, a project for the construction of flood-control works on Lake Okeechobee in Florida is pending in the rivers and harbors bill. This bill has passed the House and has received the approval of the Senate commerce committee, but has not been acted upon by the Senate. It has been decided by Senate leaders to defer action on the measure until the tariff bill is out of the way.

The Florida delegation decided on the strategy of attaching the Okeechobee project to the rivers and harbors bill after it began to appear that it would be difficult to get the measure before Congress as a separate bill. As the

rivers and harbors bill passed the House, it provided for the construction of 31-ft. levees along Lake Okeechobee and other improvement work recommended by the army engineers. The House bill required a local contribution of $4,546,000. This was reduced by the Senate commerce committee to $2,000,000.

Boulder Dam Contracts Approved

Approval of the power contracts whereby the Interior Department has underwritten the costs of the Boulder dam project was handed down by the Department of Justice on June 9. The House committee on appropriations, which has been holding the second deficiency bill for this decision, immediately returned a favorable report on the measure, which appropriates the $10,660,000 required to start construction on the project. Early House and Senate passage can be expected.

In passing upon the contracts, Attorney General W. D. Mitchell declared that they are valid and binding upon the parties and that they entirely satisfy the requirements of the Boulder Canyon act, standing as an express obligation to pay for electrical energy in definite quantities. He was inclined to minimize the objection that the Metropolitan Water District had not voted bonds to build the aqueduct for which the power would be used before signing for the electricity to be used. Secretary Mitchell was inclined to liken this in effect to the "hen and egg" argument, saying that is matters little which comes first. Anyhow, he pointed out, contracts of the city of Los Angeles and the Southern California Edison Co. in themselves serve to satisfy the act requirements to the letter.

Irrigation in Virgin Islands

Possibilities of irrigation on the Virgin Islands to put the newest of the insular possessions on a paying basis will be studied by two federal bureau chiefs who are planning to sail on June 19. The party will include H. D. Brown, chief of the bureau of efficiency, who from an earlier visit has prepared a report on the islands; Elwood Mead, commissioner of reclamation; and W. H. Nalder, of the Denver reclamation office, who is expected to stay for detailed surveys. Sugar would be the main product resulting from the proposed irrigation.

Increased Federal Aid to Roads

With the assurance that the bill providing for the construction of through roads on unappropriated public lands at federal expense will become a law before the adjournment of Congress, this session is destined to be a notable one in highway history. The rate of federal aid was increased from $75,000,000 to $125,000,000 annually and the appropriations for forest roads were also materially increased in amount. Money was authorized so as to allow this government to co-operate with the governments of Latin America in making a preliminary report on Pan American highway construction.

Personal Notes

W. F. McLaren, of Hamilton, has been elected president of the Hamilton branch of the Engineering Institute of Canada.

B. B. Somervell, Major, Corps of Engineers, will be transferred about Sept. 1 from duty as district engineer in Washington to New Orleans to assist in flood-control work on the Mississippi.

Emil F. Zabel, city engineer at Seymour, Ind., has resigned to assume his new duties as county surveyor, to which post he was appointed to fill the unexpired term of E. B. Douglass, deceased.

H. B. Fritz, of Ames, Iowa, has been appointed city engineer for the city of Bettendorf, succeeding Frank Seymour, who has resigned. Mr. Ames is a graduate of the Iowa State College.

E. A. Kingsley, who, as announced here last week, was appointed consulting engineer for Oklahoma City, Okla., has declined the appointment because of superseding business obligations.

Norman Ruthwell Gibson, vice-president and chief engineer of the Buffalo, Niagara & Eastern Power Corporation, Buffalo, N. Y., has been awarded the Cresson medal by the Franklin Institute, of Philadelphia.

Glenn B. Woodruff, for the past seven years principal assistant engineer for Ralph Modjeski and the firm of Modjeski & Moran and previously assistant bridge engineer of the Lehigh Valley Railroad, has established himself as consulting engineer in New York City. He has been retained by the public works department of New York State for the design of a proposed new highway bridge across the Hudson River near Catskill.

T. Keith Legare, of Columbia, S. C., has resigned as vice-president and sales engineer of the Carolina Concrete Pipe Co. and will resume the active practice of professional engineering. Mr. Legare will continue to have his headquarters in Columbia for the present.

William N. Carey, formerly construction engineer, has been appointed chief engineer of St. Paul, Minn., to succeed John W. Kelsey, who has resigned to enter the contracting field. John Reardon, formerly assistant engineer, has been made construction engineer.

Harrison P. Eddy, of Metcalf & Eddy, consulting engineers, Boston, will receive the honorary degree of Doctor of Engineering from the Worcester Polytechnic Institute on June 13. Mr. Eddy was graduated from the Institute in the class of 1888.

Frederick W. Fisher, for the past 21 years connected with the Rochester Gas & Electric Corp., of Rochester, N. Y., first as field engineer and then in charge of public relations, has been made director of public and personnel relations of the Associated system with properties in 42 towns and cities.

Wolf, Sexton, Harper & Trueax, Inc., engineers and architects, of Chicago, have changed the firm name to Wolf, Anderson, Harper & Trueax, Inc.

Obituary

Herman Longere, general contractor, of Indianapolis, Ind., died recently in that city. Mr. Longere was born in Germany but had been in the contracting business in Indianapolis for 42 years. He was 71 years old.

Dow R. Gwinn, former president of the American Water Works Association and until 1924 president of the waterworks of Terre Haute, Ind., died on June 4 at the home of his son in New Albany, Ind. Mr. Gwinn was 67 years old.

Thure de Thulstrup, artist, illustrator and engineer, died June 9 in New York City at the age of 82. Born in Sweden, he was educated at the National Military Academy in Stockholm, after which he saw service in Algiers with the French Foreign Legion. He later took part in the Franco-Prussian War. After a short period of art study in Paris, Mr. de Thulstrup, at the age of 27, left for Canada, where he engaged in topographical work. Moving to Boston, he drew maps for use in an atlas and, in his spare time, made drawings for the magazines with such success that he subsequently served on the staffs of the New York *Daily Graphic*, *Frank Leslie's Weekly* and *Harper's Weekly*. He also perfected himself in painting, producing a number of canvases depicting scenes in early Colonial times.

Society Calendar

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; annual meeting, Atlantic City, N. J., June 23-27.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; annual convention, Cleveland, Ohio, July 9-11.

NATIONAL SAFETY CONGRESS, Chicago; annual meeting, Pittsburgh, Pa., Sept. 29-Oct. 3.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, Pittsburgh, Pa.; 38th annual meeting, Montreal, Canada, June 26-28.

WORLD POWER CONFERENCE, second plenary meeting, Berlin, Germany, June 16-25. American secretary, O. C. Merrill, Washington, D. C.

AMERICAN SHORE AND BEACH PRESERVATION ASSOCIATION will hold its regular meeting at Long Beach, Calif., July 15-19. Among the speakers will be Major-Gen. Lytle Brown, Chief of Engineers, on "The Corps of Engineers' Interest in Shore and Beach Preservation." The secretary is Victor Gelineau, Jersey City, N. J.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS will meet at Minneapolis June 24-27.

NATIONAL CONFERENCE ON CITY PLANNING will hold its 22d meeting in Denver, Colo., on June 23-26.

SMOKE PREVENTION ASSOCIATION will hold its annual meeting at Newark, N. J., June 23 to 26. The secretary is Frank A. Chambers, Chicago.

VIRGINIA WATER AND SEWAGE WORKS ASSOCIATION will hold its second annual convention in Norfolk, Va., June 19-20. The program includes papers on treatment of raw water supplies, on impounding reservoirs and maintenance of watershed areas and on methods of sewage treatment. H. W. Snidow, Richmond, is secretary.

Construction Equipment and Materials

Water Works Manufacturers Elect Officers

At the recent meeting of the Water Works Manufacturers' Association, held in St. Louis, Mo., in connection with the annual meeting of the American Water Works Association, officers were elected as follows: president, H. Seaver Jones, vice-president, East Jersey Pipe Co.; vice-president, Willard Chevalier, publishing director, *Engineering News-Record* and *Construction Methods*; secretary, John A. Kienle, vice-president, Mathieson Alkali Works; treasurer, Edgar J. Buttenheim, president and manager, *The American City*. One change was made in the executive committee, the Central Foundry Co. being replaced by the Hydraulic Development Co., with Guy C. Northrup as representative.

Lime Association Discusses Prospects

The outlook for the lime industry was the main topic presented, from several viewpoints, at the twelfth annual convention of the National Lime Association, held at Chicago on June 3 and 4, and presided over by B. L. McNulty, chairman of the board of directors. After an address of welcome and some routine business a paper on "What's Ahead for the Lime Industry" was given by Norman G. Hough, president and general manager, which was followed by some active discussion. Other papers were on the prospects for construction lime, by C. E. Ellsworth, construction engineer; for chemical lime, by W. V. Brumbaugh, assistant secretary; and for agricultural lime, by H. A. Huschke, director of the agricultural department. A review of the lime industry's publicity campaign was presented by W. J. Chandler, of the Thomsen-Ellis Co., while Charles Warner presented his report as the association's representative on the National Business Survey Conference.

New Developments

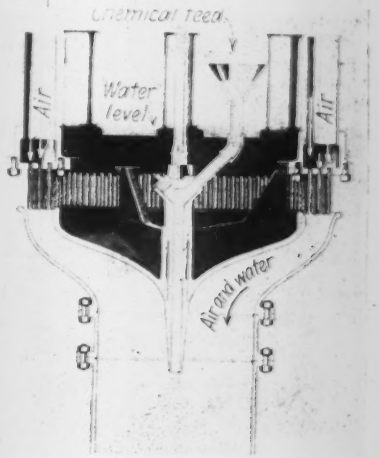
Electric Remote Control System Extends Manual Operation

Control of a valve or other movable device from a distance, while retaining the ability of the operator to "feel" the operation of the remote unit, is provided for in a system of remote control by electrical means developed by Luis de Florez, consulting engineer, and now being manufactured by the Brown Instrument Co., Philadelphia, Pa. In this system the receiving mechanism follows accurately the motion of the transmitter, which, in turn, presents resistance to motion comparable with what would be felt if the operation were being performed manually.

The system utilizes self-synchronizing alternating-current motors which have the property of remaining accurately in phase. These units, known as Selsyn motors, are products of the General Electric Co. which have been used hitherto in connection with fire control on battleships. They are made in three sizes. The transmitting unit is made up in small panels, approximately 30x16 in., which can be attached to control panels or assembled in batteries. A pointer or indicator is connected to the motion of the transmitter wheel, and a pilot light is incorporated in the unit to indicate when the circuits are energized. The receiving mechanism can be applied to any type of valve, or can be used to effect any rotary motion desired. Ample power is provided to start valves from fully closed jammed position when necessary.

Combined Aerator and Mixer Uses Injector Principle

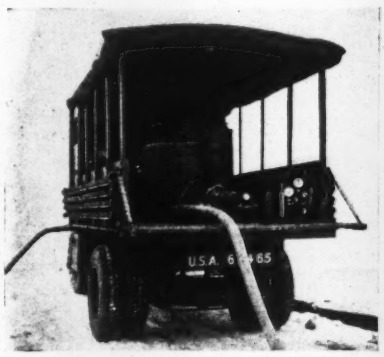
Thorough aeration of water for a definite and predetermined interval combined, when desired, with an intimate mixture of any chemical commonly used in water treatment is provided for in a new device developed by Henry A. Allen, consulting engineer, and manufactured by the Vogt Brothers Manufacturing Co., Louisville, Ky. This is known as the Aer-O-Mix, and consists of two general divisions, a head and mixing throat and a U-pipe. Many

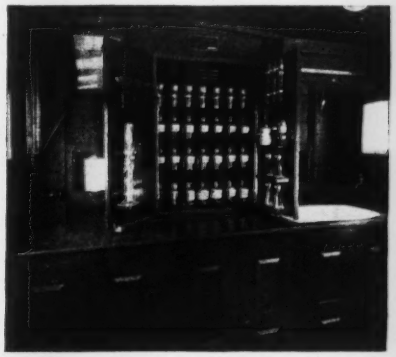


SECTION OF MIXING HEAD, SHOWING CAPILLARY AIR TUBES

advantages are claimed for this system, including more thorough aeration and mixing action, longer contact between air and water, ease in installation and maintenance (due to the absence of moving parts) and low power or head consumption.

As shown by the illustration, water enters the mixing head at the sides and is drawn vertically downward past the ends of a large number of brass tubes. Air is sucked in through these tubes and is carried downward through the vertical draft tube with the water. Due to the lightness of the air, the bubbles continually tend to rise, but are carried downward by the flow. This conflicting action breaks the bubbles up and induces a thorough mixing action which aids in diffusing any chemical which may be introduced through the feed tube at the center of the head. As the mixture of water, air and chemical is carried through the U-shaped pipe, this mixing action is increased by fixed baffles in





TRUCK-MOUNTED WATER-PURIFICATION PLANT FOR THE U. S. ARMY

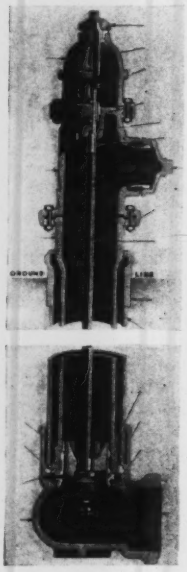
Exterior and interior views of the first of six water-purification units to be delivered to the Corps of Engineers, U. S. Army. These will be used in the treatment of water for the use of troops in the field. Besides a compact laboratory for testing purposes, each truck carries a Roberts rapid sand filter and Paradon dry-feed chlorination equipment. Each outfit, mounted on a 3½-ton Four-Wheel-Drive truck, will supply 120 gal. per minute.

both the horizontal section and the riser. At the top of the vertical riser the water cascades into the coagulating basin, while the air and any gases that may be present pass off into the atmosphere. The header is equipped with an adjusting cam and gear so that its height can be adjusted for varying water levels and to take care of changes in flow. When consumption varies considerably, a number of units may be used in a multiple installation.

The difference in head between the initial and final water level is, in the usual installation, between 5 and 8 ft., this head being utilized to operate the system. In special cases where head must be conserved, power blowers are added to the air supply system. Aside from these blowers, when used, there are no moving parts in the entire installation. As the efficiency of an aerating device depends largely on the length of time during which the air and water are in contact, the Aer-O-Mix system claims unusual efficiency with low consumption of power or head. Another advantage claimed is that the air used may be piped from a clean source of supply or may be treated to remove dust and impurities. Aer-O-Mix units are made in a variety of sizes to meet all conditions of installation, and are also applicable in the treatment of other fluids, such as chemicals used in industrial plants.

Street Hydrant Improved

To meet the demand for hydrants which will be more resistant to breakage and more easily replaced without digging or breaking the pavement, the Mathews hydrant, a product of R. D. Wood & Co., Philadelphia, Pa., has been improved and modernized in several particulars. A feature of this hydrant has always been the removability of the barrel without digging. This is now made even easier by four lugs which have been cast on the outside of the barrel of the base. A tube wrench slips over these lugs to unscrew the barrel. At the top of the hydrant a malleable-iron shield-operating nut fits down over the bronze operating nut to prevent rain and sleet from seeping down and freezing around the latter. The wrought-iron operating stem is bronze bushed at the stuffing box to prevent undue wear on the packing. The stuffing box plate is cast integral with the nozzle section, eliminating a separate part. Facing the hydrant in any direction without disturbing the barrel is made possible by simply loosening the bolts in the swivel clamping ring and rotating the head. To assure greater resistance to shock, the barrel and protection case sections are cast by the sand-spun method, which produces concentric castings of greater tensile strength, elasticity and toughness. The cost of replacing broken hydrants has been further reduced by the adoption of a beaded protection case extension which slips down over the regular protection case.



IMPROVED HYDRANT

Wide World Photo

LOCATING A LOST WATER MAIN IN LONDON

Municipal authorities in London, England, testing a radio detector device for locating pipe lines. It is claimed that when the aërial is held directly above a gas or water pipe, the instrument will transmit a signal through the ear phones, thus eliminating unnecessary digging in locating lost mains.

Business Notes

NATIONAL ASSOCIATION OF PARIS TRANSIT MIXED CONCRETE MANUFACTURERS was formed at a convention held recently in Chicago, Ill. Officers elected at that time include: president, Porter W. Yett, of Swigert, Hart & Yett, Portland, Ore.; secretary, Charles P. Maloney, Maloney Paving Co., Washington, D. C.; treasurer, Bruner R. Penniman, Penniman Gravel & Materials Co., Dallas, Tex. Executive offices have been established in Portland, Ore.

SQUARE D CO., Detroit, Mich., and DIAMOND ELECTRICAL MANUFACTURING CO., Los Angeles, Calif., have merged their interests. Hereafter the Diamond company will operate as a subsidiary of Square D. Sales in the West will be handled by the Diamond organization, while those in the East will be taken care of through the offices of the Square D Co.

PHOENIX METER CO. has been acquired by a new organization headed by Victor Arnold, with Ernest Gamon as consulting engineer. Sales and executive offices are at New York City.

GREAT LAKES STEEL CORP. has completed construction of the water-intake system for its new mill at Detroit, Mich. Three pumps, each with a capacity of 20,000 gal. per minute, have been installed to supply the initial requirements of the new plant, which will go into operation next fall.

AMERICAN SEWAGE DISPOSAL CO., INC., New York City, is the new name assumed by the American Sanitary Products Co., Inc. No change has been made in officers or personnel of the company.

PARADON MANUFACTURING CO., Arlington, N. J., has appointed George Bird assistant manager of sales. The territory covered by the Denver office, in charge of M. B. Urquhart, has been expanded to include the states of Utah, Wyoming and New Mexico.

CHICAGO PNEUMATIC TOOL CO., New York City, has elected W. L. Lewis vice-president, secretary and treasurer, succeeding J. G. Grimshaw, resigned. Mr. Lewis was formerly assistant comptroller for the Bethlehem Steel Corp.

UNIVERSAL POWER SHOVEL CO., Milwaukee, Wis., has appointed R. B. Crenshaw district sales presentative in the Chicago district.

HOOVER STEEL BALL CO., Ann Arbor, Mich., announces that H. E. Johnson, former sales manager of the Strom Steel Ball Co., of Chicago, has joined its sales organization.

CHICAGO BRIDGE & IRON WORKS, Chicago, Ill., has opened a new office in Houston, Tex., in charge of J. R. Donaldson, formerly at Dallas.

READING IRON CO., Reading, Pa., has increased the range of its products to include 22- and 24-in. puddled wrought-iron pipe.

ANDREWS-FREY SALES CO., Philadelphia, Pa., has been formed by E. C. Frey, formerly general manager, and F. D. Andrews, formerly general superintendent of the Harrisburg Pipe & Pipe Bending Co. The new organizatiton will handle cylinders for high-pressure gases, steel billets and bars and other steel products.

WALTER SMART MCKEE, president of the Kensington Steel Co., Chicago, Ill., died May 19.

Costs and Contracts

E. N.-R. Index Numbers

Cost			Volume		
June 1, 1930	**203.36**	**May, 1930**		**354**
May 1, 1930	205.86	April, 1930		320*
June 1, 1929	205.65	May, 1929		395
Average, 1929	207.02	Average, 1929		317
Average, 1928	206.78	Average, 1928		287
1913	100.00	1913		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of June 12, with some comparisons, total as follows:

(In Thousands of Dollars)

	June 12, 1930	Average Preceding Four Weeks 1930	1929
Buildings:			
Industrial	$10,486	$8,380	$11,727
Other	19,519	27,770	52,397
Streets and roads	21,469	19,101	16,936
Other eng. constr.	11,556	40,172	20,496
Total	$63,030	$95,424	$101,556
Total, all classes, Jan. 1 to June 12:			
1930			$1,708,990
1929			2,091,769

Unit Prices From Current Construction Bids

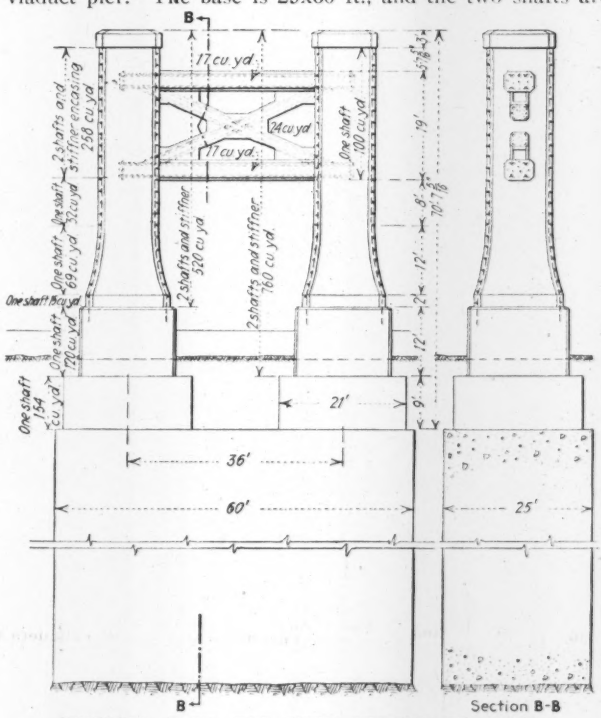
High-Level Concrete Highway Viaduct on Jersey Meadows

THE foundation work of the high-level connecting link (Route 25) in the Jersey City-Newark (N. J.) state highway is divided into eight sections, of which five were awarded in three contracts in April, 1930, as follows: Sec. 2 (Cont. 29), Tunnel Construction Corp., New York, $979,250; Sec. 3-4 (Cont. 30), Arthur McMullen Co., New York, $3,176,530; Sec. 5-6 (Cont. 32), Foundation Co., Newark, $1,609,784. The foundations for Sec. 7 and 8 at the westerly end of the 18,000-ft. viaduct will probably be ready for estimate in August. Sec. 1 at the easterly end, which will be a general contract including both foundation and superstructure, is expected to be ready for estimate about Feb. 1, 1931.

The route is from Van Wagenen Ave. in Jersey City, across the Hackensack River, through Kearny, across the Passaic River, and a short distance along the Pennsylvania R.R. in Newark. The site is the Hackensack Meadows, and the soil is swamp mud underlain with sand and rock. The foundations are concrete piers on piles, as in Sec. 2, or on caissons, as in Sec. 4 to 6.

Sec. 2 consists of eighteen piers carried on Raymond concrete piles about 30 ft. long driven into sand and battered 1:4. The maximum pile load is 50,000 lb., and in piers 58 and 59 (typical for this section) there are 272 and 308 piles. The base of pier 58 is 40x60 ft., tapering in 9 ft. to $24\frac{3}{4}$x$49\frac{1}{4}$ ft. The two pier columns, of reinforced concrete, 36 ft. center to center, are approximately $9\frac{1}{2}$x11 ft. by $14\frac{1}{6}$ ft. high. Pier 62, near the Hackensack River crossing, is 49x69 ft. base plan and $65\frac{1}{2}$ ft. above pile tops, and is carried on 383 piles. The two pier columns are crossbraced by a concrete truss heavily reinforced.

Sec. 3, 4, 5 and 6 include the two river sections of three spans each, with seventeen viaduct spans between them. These piers, as well as the river piers, are all to be sunk to rock by caisson. Pier 69, shown in the drawing, is a typical viaduct pier. The base is 25x60 ft., and the two shafts are on concrete pedestals 21x22 ft. by 9 ft. high. The height above top of pedestal is $61\frac{1}{2}$ ft. The amounts of shaft concrete required for the various portions are stated on this drawing.



TYPICAL PIER FOR NEW JERSEY VIADUCT

Sec. 2—Contract 29

	A	B	C
2,600 cu.yd. foundation excav.	$2 60	$4 00	$3 00
3,000 cu.yd. foundation excav.	5 00	4 00	4 00
1,600 cu.yd. excav. for ditches	3 50	4 00	3 00
2,300 cu.yd. garbage excav.	2 50	4 00	3 00
17,000 cu.yd. roadway embankment	1 00	1 20	75
60,000 cu.yd. surface fill	1 00	1 20	75
5,700 cu.yd. fill under structure foundation	3 50	4 00	3 00
3,600 lin.ft. timber piles	60	1 00	1 00
26 loading tests of piling	300 00	300 00	300 00
Concrete Piles			
60,000 lin.ft.	2 03	2 17	2 25
85,000 lin.ft.	2 03	2 17	2 25
10,000 lin.ft.	2 03	2 17	2 25
15,000 lin.ft.	2 03	2 17	5 00
20,000 lin.ft.	2 03	2 17	5 00
985 cu.yd. class B concrete	24 00	20 00	18 00
18,500 cu.yd. class C concrete	16 00	13 00	13 00
4,900 sq.yd. surface finish	1 00	1 00	1 00
155 ton structural steel	130 00	135 00	120 00
440 ton bar reinforcement	100 00	100 00	120 00
Engineer's office (lump sum)	4,000 00	4,300 00	10,000 00
Totals	$979,250	$1,004,825	$1,053,230

Sec. 3 and 4—Contract 30

	A	B	C
11,000 cu.yd. foundation excav.	$7 00	$6 00	$3 65
10,000 cu.yd. roadway embankment	1 00	1 00	1 00
100 cu.yd. fill under structure foundation	3 00	4 00	4 50
6,600 lin.ft. timber piling	1 00	60	1 50
5 loading tests of piling	150 00	300 00	500 00
37,000 cu.yd. pier bases (top)	28 60	25 00	30 00
Pier Bases (below)			
4,600 cu.yd.	28 60	26 00	30 00
3,700 cu.yd.	28 60	26 00	30 00
3,500 cu.yd.	28 60	26 00	30 00
3,500 cu.yd.	28 60	28 00	30 00
3,500 cu.yd.	28 60	28 00	30 00
3,500 cu.yd.	28 60	28 00	30 00
3,500 cu.yd.	28 60	28 00	30 00
3,300 cu.yd.	28 60	28 00	30 00
3,000 cu.yd.	28 60	33 00	30 00
3,000 cu.yd.	28 60	33 00	30 00
2,500 cu.yd.	28 60	33 00	30 00
2,500 cu.yd.	28 60	33 00	30 00
2,300 cu.yd.	28 60	38 00	35 00
1,500 cu.yd.	28 60	38 00	30 00
800 cu.yd.	28 60	38 00	40 00
300 cu.yd.	28 60	38 00	45 00
200 cu.yd.	28 60	38 00	50 00
100 cu.yd.	28 60	38 00	75 00
100 cu.yd.	28 60	45 00	100 00
3,000 cu.yd. rock excav.	20 00	10 00	57 00
2,000 bbl. cement for grouting	6 00	6 00	15 00
1,300 cu.yd. class B conc.	15 00	25 00	44 00
18,000 cu.yd. class C conc.	13 00	30 00	27 25
13,300 sq.yd. surface finish conc.	80	1 00	2 00
2,500 cu.yd. granite facing and conc.	30 00	56 00	47 50
600 ton structural steel	130 00	140 00	120 00
2,200 ton bar reinforcement	100 00	70 00	100 00
81 ton cast iron pipe	100 00	100 00	110 00
Engineer's field office (lump sum)	8,000 00	4,000 00	11,500 00
Totals	$3,176,530	$3,381,060	$3,795,960

Sec. 5 and 6—Contract 32

	A	B	C
7,000 cu.yd. foundation excav.	$15 00	$7 00	$10 00
Pier Bases			
19,300 cu.yd.	25 00	32 00	33 00
2,800 cu.yd.	25 00	32 00	33 00
2,800 cu.yd.	25 00	32 00	33 00
2,130 cu.yd.	25 00	32 00	33 00
1,950 cu.yd.	25 00	32 00	33 00
1,780 cu.yd.	25 00	32 00	33 00
1,600 cu.yd.	25 00	32 00	33 00
1,200 cu.yd.	25 00	32 00	33 00
830 cu.yd.	25 00	32 00	33 00
830 cu.yd.	25 00	32 00	33 00
830 cu.yd.	25 00	32 00	33 00
720 cu.yd.	25 00	32 00	33 00
560 cu.yd.	25 00	32 00	33 00
560 cu.yd.	25 00	32 00	33 00
560 cu.yd.	25 00	32 00	33 00
230 cu.yd.	30 00	32 00	33 00
100 cu.yd.	30 00	32 00	33 00
100 cu.yd.	30 00	32 00	33 00
100 cu.yd.	30 00	32 00	33 00
100 cu.yd.	30 00	32 00	33 00
1,500 cu.yd. rock excav.	15 00	32 00	10 00
1,000 bbl. cement for grouting	8 00	6 00	5 00
950 cu.yd. class B conc.	44 00	20 00	30 00
8,650 cu.yd. class C conc.	24 00	16 00	20 00
7,300 sq.yd. surface finish conc.	2 40	80	1 00
1,760 cu.yd. granite facing	28 50	32 00	30 00
380 ton structural steel	135 00	150 00	130 00
1,290 ton bar reinforcement	94 00	110 00	70 00
42 ton cast iron pipe	107 00	100 00	100 00
Totals	$1,609,784	$1,776,220	$1,785,140

Hackensack River piers 65 and 66 and the Passaic River piers 85 and 86 are the highest of the entire project. The bases are 36x83 ft. in plan. The shafts rest on a pedestal 27x80 ft. by 11 ft. high, and are faced with granite. They rise 89 ft. above top of pedestal (the bridge itself will be 135 ft. clear), and are stiffened by a heavy concrete truss.

Bidding—On the five sections, seventeen bids were received from eleven contractors. Unit prices are given of the lowest three bidders on each of the three contracts, who were: *Cont. 29:* (A) Tunnel Construction Corp., New York; (B) C. T. Kavanagh, Bayonne; (C) Pierce Steel Pile Co., New York. *Cont. 30:* (A) Arthur McMullen Co., New York; (B) Montrose Contracting Co., New York; (C) Foundation Co., Newark. *Cont. 32:* (A) Foundation Co.; (B) Arthur McMullen; (C) Senior & Palmer, Inc., New York.

Ties for New York Subways

BIDS were received March 4, 1930, for untreated and treated ties for New York subway lines. For the untreated ties six bids were received, low being $38,132, next $38,137, average $49,827. These are Class A, high-grade, longleaf yellow pine sapwood. Lengths vary from 8 to 22½ ft. for 6x8's and 8x8's. The table gives the prices on representative items.

The treated ties are rated Class C and are 6x10-in., varying in length from 2½ ft. to 7 ft. 5 in. Bids were asked on a dozen types, based on size and amount of drilling. The average prices submitted by the four bidders were $1.17, $1.19, $1.29, $1.41.

Quantity	Length	Unit Prices 1	2	3
Class A, Untreated 6x8-in. ties:				
1,670	8 ft.	$1.79	$1.67	$1.76
85	8 ft. 6 in.	1.90	1.78	1.87
525	9 ft.	2.01	1.91	1.98
42	9 ft. 6 in.	2.13	2.01	2.09
45	10 ft.	2.24	2.11	2.20
42	10 ft. 6 in.	2.35	2.22	2.31
38	11 ft.	2.46	2.32	2.42
21	11 ft. 6 in.	2.57	2.43	2.53
24	12 ft.	2.69	2.54	2.64
23	12 ft. 6 in.	2.80	2.64	2.75
19	13 ft.	2.91	2.75	2.86
14	13 ft. 6 in.	3.02	2.85	2.97
20	14 ft.	3.13	2.96	3.08
18	14 ft. 6 in.	3.25	3.06	3.19
9	15 ft.	3.36	3.17	3.30
4	15 ft. 6 in.	3.47	3.28	3.41
2	16 ft.	3.58	3.38	3.53
24	21 ft. 6 in.	4.81	4.72	4.75
14	22 ft. 6 in.	5.04	4.94	4.97
Class A, Untreated, 8x8-in. Ties:				
2	8 ft.	$2.39	$2.29	$2.34
2	8 ft. 6 in.	2.54	2.43	2.50
96	9 ft.	2.69	2.61	2.62
32	11 ft.	3.28	3.19	3.23
26	9 ft.	2.6	2.54	2.64
12	9 ft. 6 in.	2.85	2.68	2.78
3	10 ft. 6 in.	3.13	2.96	3.08
4	12 ft. 6 in.	3.75	3.52	3.67

Approaches and Superstructure for McKees Rocks Bridge, Pittsburgh

THE McKees Rocks highway bridge for Allegheny County, Pa., has been awarded in three contracts totaling $4,868,233. Contract 1, for the concrete substructure, was awarded in the summer of 1929 to the Dravo Contracting Co., Pittsburgh, for $1,780,150. The two other contracts, for superstructure and approaches, were awarded this year.

The principal feature of the project, as the drawing shows, is an 800-ft. steel arch of the Hell Gate type. It is flanked by four spandrel-braced arches with horizontal top chord, 340 ft. between pier centers, and nine 160-ft. deck trusses. At the west end are two arches with floor ties, crossing the tracks of the Pittsburgh & Lake Erie Railroad. The roadway is 40 ft., with two 6-ft. sidewalks.

The lowest three bids on the superstructure (Table I) were: (A) Fort Pitt Bridge Works, Fort Pitt (contract); (B) McClintic-Marshall Co.; (C) Independent Bridge Co.

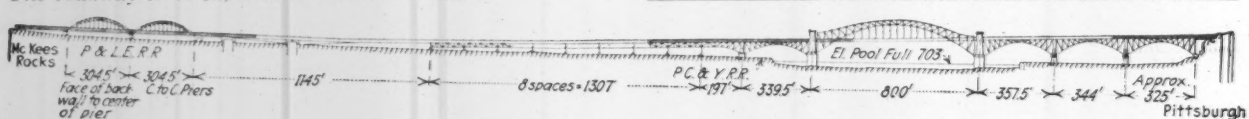
Lowest three on the approaches (Table II) were: Van Construction Co., Grant Bldg. (contract); (B) Booth & Flinn, 1942 Forbes St.; (C) John F. Casey Co.

TABLE I—SUPERSTRUCTURE

Fabricate, Paint, Deliver at Site	A	B	C
400,000 lb. cast steel	$0.08	$0.0845	$0.05
4,500,000 lb. copper-bearing silicon steel	0.0464	0.0417	0.042
21,000,000 lb. copper-bearing carbon steel	0.0385	0.0381	0.042
25,900,000 lb. erect and field coat above items	.018	0.0205	0.016
16,000 lb. chrome nickel iron alloy in place	0.70	1.25	0.45
200 cu.yd. concrete in place	30.00	28.50	10.00
1,000 lin.ft. wrought-iron drain pipe in place, painted	2.50	3.00	1.00
2,000 lin.ft. white oak stair treads in place	0.25	0.65	0.12
10,000 lb. sheet copper for troughs in place	0.40	0.55	0.45
	$1,539,700	$1,588,000	$1,647,840

TABLE II—APPROACHES

	A	B	C
492,000 cu.yd. excav.	$0.70	$0.68	$0.75
9,000 cu.yd. foundation excav.	2.00	3.37	2.05
9,000 cu.yd. plain Class A conc. in retaining walls and footers	16.50	11.86	14.00
1,000 cu.yd. reinf. Class A conc. in retaining walls and footers	16.00	12.00	18.50
175,000 lb. steel reinf. bars	0.04	0.04	0.06
3,800 lin.ft. 24-in. t. c. channel pipe (double strength)	2.50	1.40	1.75
2,800 lin.ft. 15-in. reinf.-conc. pipe culvert	3.00	2.10	3.00
300 lin.ft. 18-in. reinf.-conc. pipe culvert	4.00	2.50	3.50
100 lin.ft. 24-in. reinf.-conc. pipe culvert	5.00	3.50	5.00
27,200 sq.yd. plain Class A conc. in base course (9-in.)	3.00	1.75	2.42
1,600 sq.yd. 2-in. asphaltic wearing surface	2.00	1.50	1.75
30,450 sq.yd. vitr. brick pavement	2.50	2.22	2.68
900 lin.ft. sandstone curb recut and reset	1.00	1.25	0.80
200 lin.ft. sandstone curb	2.00	2.25	1.50
12,000 lin.ft. granite curb with broken stone drain	2.75	3.15	2.70
200 lin.ft. granite radius curb with broken stone drain	3.00	3.50	3.50
40,000 sq.ft. Class A conc. sidewalk	0.35	0.23	0.25
7,000 sq.yd. tar waterproofing, (including two layers membrane waterproofing at joints	0.50	0.60	0.40
8,000 cu.yd. top soil (9 in.)	4.50	4.0	3.00
28,072 cu.yd. excav. for foundations, including removal of existing masonry	2.00	6.00	2.65
1,162 cu.yd. conc. in foundations of California Ave. underpass, except toe walls and bases of reinf. cantilever walls	13.00	15.00	14.45
5,350 cu.yd. conc. above foundations in California Ave. underpass and approach walls, including bases of reinf. cantilever walls	15.00	17.00	18.35
2,234 cu.yd. conc. in arch abutments of Bridge No. 1, Woods Run	13.00	15.00	18.45
1,176 cu.yd. conc. in end abutments and wing walls of Bridge No. 1 Woods Run, except toe walls	15.00	16.00	19.80
400 cu.yd. conc. in footbridges and conc. stairs	25.00	22.00	31.25
1,800 cu.yd. conc. in toe walls and column foundations	13.00	15.00	18.85
5,171 cu.yd. conc. in Bridge No. 1, Woods Run, not included under other items	27.00	25.00	30.60
27,300 cu.yd. conc. admixtures	0.10	0.30	0.26
2,700 sq.yd. tar waterproofing on walls, including membrane waterproofing at vertical joints	0.50	0.60	0.40
2,600 sq.yd. three-layer membrane waterproofing	2.20	1.70	.10
1,500 cu.yd. gravel drains	2.50	4.00	3.25
2,000 bbl. extra portland cement	2.00	2.00	2.25
1,300,000 lb. steel reinforcing, dowels and bent rods in place, including all welding	0.04	0.04	0.05
26,000 lb. structural steel frames in arch ribs, hook bolts, anchor bolts, and clamps in place	0.10	0.08	0.08
14,000 lb. chrome nickel iron in place	0.70	0.80	1.00
10 roadway and sidewalk expansion joints, including structural steel angles, anchor bolts, copper troughs, joint filler and glazed tile	450.00	300.00	300.00
47,400 lb. fabricating, painting and delivering structural steel for foot bridges and stairs	0.07	0.065	0.06
300,000 lb. fabricating, painting and delivering malleable iron in all hand railing for bridges, stairs and walls	0.14	0.16	0.155
1,000 lb. fabricating, painting and delivering cast steel	0.16	0.20	0.11
348,400 lb. erecting and painting all materials included under above three items	0.023	0.02	0.03
500 lin.ft. metal safety treads on conc. stairs	2.00	1.50	1.75
400 sq.ft. grating for steel stairs	2.50	2.00	1.25
1,200 lin.ft. granite bridge curb	2.00	1.65	2.25
1,200 cu.yd. granite slag embankment	2.50	1.50	2.20
3,000 cu.yd. conc., additional compensation for high-early-strength portland cement	1.00	2.00	2.64
Totals	$1,369,533	$1,399,762	$1,469,099



MCKEES ROCKS BRIDGE FOR ALLEGHENY COUNTY, PA.